

Classrooms for the Future Year Two Evaluation Report

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Executive Summary

The purpose of the Classrooms for the Future (CFF) initiative is to transform Pennsylvania's high schools, making them more engaging and more responsive to the economic challenges presented by globalization. This high school reform initiative is at the same time an effort to enhance teaching and learning, an effort to promote access to technology, an effort to foster the effective use of that technology, and an effort to enhance our ability to compete in an increasingly global marketplace. As such, this reform initiative is increasing the number of powerful computers available for student use, with the goal of a laptop computer on every student desk in every public high school classroom in which the four core subjects are taught. CFF is also providing increased access to technology for teachers, with a multimedia teaching station in each classroom, and is making a significant investment in the professional development of teachers, providing face-to-face and online learning experiences, and providing the ongoing assistance required to support a change of this magnitude.

This evaluation used classroom observations by trained observers, teacher and student surveys, and interviews with CFF coaches, principals, building contacts, and technology coordinators to assess the progress being made. Although this is the second year of the program, the results in this report must still be considered preliminary, as the skills the teachers and students are developing take time, and contract negotiations and other issues delayed the arrival and installation in schools (especially in Year One), limiting their use by teachers and students. The primary purpose of this report is to look for signs of change in progress – changes in teaching activity, in student activity, in teacher attitudes, and in student attitudes. A preliminary report on changes in student achievement will follow shortly, as the results of the statewide testing have only recently become available.

The evidence we have collected indicates that the desired changes do appear to be underway.

Some of the statistically significant results that were visible in data collected from CFF sites include:

- **Changes in Classroom Organization**

Observers in both Years One and Two reported that the physical organization of some classrooms is changing, from the familiar pattern of desks in rows (designed to promote the delivery of information from the teacher to the student) to more classrooms organized as clusters of three to five desks, which promotes collaboration and group work.

- **Changes in Teacher Activity**

Observers in both Years One and Two reported that in the "post" observations, teachers were spending significantly less time in whole class lecture and were spending more time working with individual students and walking through the room observing, and interacting with students. This observation was verified by data from the teacher and student surveys, and again verified by comments made by CFF principals, technology coordinators, and coaches.

- **Changes in Educational Goals**

Teacher and students surveys and interviews with CFF leaders all provide evidence that teachers are more likely to engage students in activities requiring higher order thinking as a result of the CFF program.

There were significant increases in the use of project- or problem-based learning, authentic learning, multi-modal teaching, peer teaching, and in both informal collaborative learning and collaborative learning with formal assigned roles to participants.

Significant increases from pre to post observations were observed in time spent focusing on the development of most of the identified 21st century skills, including Visual Literacy, Teaming or Collaboration Skills, E-communication Skills, Social or Personal Responsibility, Self Direction, Creativity, Use of Real World Tools, The Ability to Produce High-Quality Products, and Planning, Prioritizing, and Managing Work. Significant differences were not found for Scientific Literacy, Cultural Literacy or Global Awareness, and Higher Order Thinking.

- **Changes in Teaching Activity Associated with Student Achievement**

Although this report does not directly examine changes in student achievement (which will be investigated in a separate report in the coming months), we did use the "Teaching Performance Record" (TPR) classroom observation protocol to evaluate teacher activities based on five domains of activity that have been linked, through prior research, with increases in student achievement. Statistically significant increases in teacher behaviors associated with all of the five domains were identified, implying that teachers are working in ways that are more directly associated with increasing student achievement.

- **Changes in Student Activity and Level of Engagement**

The pre/post analysis of surveys, classroom observations, and interviews indicates that students spent significantly less time listening to the teacher in

large group settings. Students spend more time working independently and in groups, and are more likely to be working on reports, projects or presentations. Students are more likely to be able to demonstrate their learning in a variety of ways, more likely to be able to choose projects based on interest, and more likely to be working at their own pace. Student work is more likely to be assessed using a rubric to assess the quality of the product or project.

Teachers and observers reported that students spent significantly less time "off task" (doing things other than what the teacher had intended), but students reported that they spend slightly more time off task.

The *percentage* of students engaged was relatively high in both pre and post observations. Significant pre/post differences on the teacher survey indicate that more students were engaged, and the classrooms observations confirmed that the percentage of students engaged had increased during the last third of the class. Evidence from the class observations also showed that the level of student engagement, and the degree of interest being shown, was also greater during all three thirds of the class session (beginning, middle, and end).

- **Changes in Technology Use**

As might be expected, there was a significant decrease in the number of students who were observed not using technology at all during the lesson, and a corresponding increase in the number of students observed to be using technologies almost the entire class period.

- **Changes in Teacher Attitudes**

Changes in teacher attitudes related to the value of technologies exhibited between the pre and post surveys were small, perhaps because approximately 75% of teachers perceived technologies as either valuable (47%) or very valuable (28%) at the time of the initial survey. The percentage reporting that they felt technologies were very valuable had increased by 10% by the time of the post survey.

At the end of the school year, 14% more teachers reported that given the tools and resources available to them, the experience they were able to offer their students was very good (up 7% to 48%) or excellent (up 7% to 29%).

Approximately 73% of teachers feel better prepared to teach this year than last year, although about 20% expressed the belief that they do not yet have the technology skills needed to teach their subjects using the best methods available.

Ninety-one percent of teachers reported that they are working harder than they were in past years, and approximately the same number (85%) reported that they are also working longer.

Approximately 76% of the teachers reported that the CFF coach had been either valuable (40%) or very valuable (36%), and the three services the coaches provide that were considered by teachers to be most important were:

- Suggesting ways to incorporate technology to teach the content in their classes
- Teaching them to operate computers, networks, or software programs, and
- Providing professional development.

- **Obstacles to Successful Implementation**

This complex, multifaceted reform initiative presents a series of challenges its leaders must understand in order to overcome. The top three issues reported by teachers are: 1) computer failures, 2) the need for continuing professional development; 3) and network downtime.

Progress is being made in terms of the time required to repair or replace a faulty computer and to reduce and quickly end network downtime, as reported by both teachers and students. There were significant differences between pre and post assessments of time to repair a failed computer, and now more than 63% of students estimate that computers are repaired in one day or less. On the PATI survey teachers indicated significantly greater levels of satisfaction with technical support than non-CFF teachers, and also indicated greater access to instructional support that helps them integrate technology.

- **Changes in 21st Century Skills**

One of the primary purposes of CFF was to help Pennsylvania's students develop "21st Century Skills," skills that will allow them to compete and thrive in a very competitive global economy. Although these skills and attributes are very difficult to measure and, therefore, are rarely the focus of research or evaluation, we feel compelled to work toward the development of processes and measures that will allow us to monitor progress in these areas, which include critical thinking, problem solving, creativity, teamwork, online research, electronic communication skills, and self-directed learning.

Although these skills and abilities develop over longer periods of time and might not be anticipated at this early stage of the CFF program, as part of this evaluation, we ran a preliminary study comparing students from two CFF schools that had implemented CFF as intended, to "control schools" selected based on demographic and past performance variables to be similar to the CFF schools in the study. We recruited paid volunteer subjects from these schools,

who worked with us on a Saturday toward the end of the school year. The compensation and recruitment processes were the same in both locations.

These students took a creativity test, developed and delivered a presentation on an assigned topic, took a content test on the topic of their presentation, took a formal reasoning test, and participated as a member of a team in a group problem-solving activity.

The presentations and group problem-solving activities were videotaped and scored by blind reviewers. The tests were also scored and the data from these sources were analyzed to determine whether any significant differences existed between the two groups.

A series of small but significant differences emerged, indicating that:

- On the creativity tests, CFF students outperformed control students in "Elaboration" and "Resistance to Premature Closure," while the control students outperformed CFF students in "Fluency and "Abstractness of Titles."
- On the presentation development task, CFF students outperformed control students in "Use of Sources," while the control students outperformed CFF students in "Mechanics," and
- During presentation delivery, CFF students outperformed control students in body language.

No significant differences were found in any of the other variables.

Remember that these skills take time to develop, and that CFF is currently a very "part time" experience for most students. These skill differences may become more prominent as more students have more time with the technologies, under the leadership of teachers who have had more time to think deeply about how to use them to accomplish both content area goals and to develop 21st century skills.

The pages that follow are designed to summarize the findings from our different sources of information, synthesizing a great deal of information in a more visual form. In the tables below you will find the columns to be our sources of information (the various surveys, observations, and interviews). If you want more information you can note the source of the data at the top of the column and find the data table in the appendix that corresponds to that data source, using the question number (i.e. "Q14") to navigate within the appendix. The rows in the charts below are the CFF research questions. Where the data related to these research questions have produced statistically significant findings indicating changes you will see a green cell. The dark green cells indicate very strong evidence, generally from multiple sources and/or both Years One and Two. The lighter green cells indicate that some of our evidence produced statistically significant differences, but not all, or that the differences were statistically significant, but are due to very small shifts from category that do not appear to justify confidence that the anticipated progress is being made. The occasional red cell indicates a statistically

significant finding that is not in the desired direction – one that seems to warrant attention. "NSD" in the tables indicates that there was no significant difference found for that item. An empty white cell means only that that source of information was not used for that particular question, but a white cell with text in it either means that there were no significant differences or that the question called for a list of topics rather than for a comparison of past to present.

Table ES-1: Summary of Findings Related to Teaching Practice

CFF's Impact on Teaching Practice	Teacher Surveys	Student Surveys	CFF Classroom Observations	CFF Leader Interviews
1. Has CFF changed classroom layout (arrangement of desks, etc.)?	Q1 Y1=Yes Y2 = Yes Fewer rooms with desks in rows, more small clusters of desks.		Q2 Y1=Yes Fewer rooms with desks in rows, more small clusters of desks. Y2 = Yes	
2. Has CFF changed the percentage of time teachers spend lecturing and in other activities?				
Whole Group Lecture/instruction	Q2a Y1=Yes. Less Y2=Yes. Less	Q2b Y1=Yes. To the middle Y2=Yes. Less	Q3a Y1=Yes. Less, all thirds. Y2=Yes. Less second and final thirds only	Less lecture
Leading Whole Class Discussion	Q2b Y1=NSD Y2=Yes. Less	Q2a Y1=Yes. To the middle Y2=Yes. Less	Q3b Y1=NSD Y2=NSD	
Working with Small Groups of Students	Q2c Y1=NSD Y2=Yes. More	Q2c Y1=Yes. More Y2=Yes. More	Q3c Y1=Yes. More Y2=Yes. More	More work with individuals
Working with Individual Students	Q2d Y1=NSD Y2=Yes. More	Q2d Y1=Yes. More Y2=Yes. More	Q3d Y1=Yes. More Y2=Yes. More	More work with groups
Walking, observing & Interacting with students	Q2e Y1=NSD Y2=Yes. More	Q2e Y1=Yes. To the middle. Y2=Yes. Less	Q3d Y1=NSD Y2=NSD	
At desk, working	Q2f Y1=Yes. More Y2=Yes. More		Q3e Y1=NSD Y2=NSD	
3. Has CFF changed the "complexity" of class content, moving from "basic skills" to more "higher-order" topics?	Q3 Y1=NSD Y2=Yes More HO	Q3 Y1=Yes. More HO Y2=Yes. Less HO	Q35, 10, 15 Y1=Yes. More HO Y2=Yes. More HO	Greater focus on higher order skills
4. Has CFF changed the "instructional style" exhibited by the teacher, on a scale from "didactic" to "constructivist"?	Q4 Y1=NSD Y2=Yes. More Constructivist	Q4 Y1=Yes. Y2=Yes. More Constructivist	Q6, 11, 16 Y1=Yes. Y2=Yes. More Constructivist	More student-centered activity
5. Has CFF changed the "relevance" of class content, moving from "artificial" to more "real world" in nature.	Q5 Y1=Yes. Y2=Yes. More Authentic or "Real World"		Q7, 12, 17 Y1=Yes. Y2=Yes. More Authentic or "Real World."	

CFF's Impact on Teaching Practice (continued)	Teacher Surveys	Student Surveys	CFF Classroom Observations	CFF Leader Interviews	PATI Survey
6. What technologies are being used in the different subject areas, and how is this changing as a result of CFF?			Q 21, 24 Y1=Yes. Y2=Yes. More tech use by teachers and students.		
7. Are teachers experiencing any changes in classroom management (discipline problems, time lost in transitions, etc.) as a result of CFF?	Q14h Y1=NSD Y2=NSD		Q2b Y1=Yes. Classroom management improved. Y2=NSD.	Discipline problems have decreased.	
8. Are teachers comfortable teaching in CFF classrooms?	Q14i Y1=NSD Y2=NSD Comfort levels are high.		Q 20 Y1=Yes. Y2=Yes. Started comfortable & got more so.	Teachers are comfortable and willing to take risks.	Q29c NSD Comfort levels are high.
9. What different software applications are being used in CFF classrooms?	Q 8 a-o Y1=Yes. Increases in 11 of 17 categories Y2=Yes. All 17 categories	Q 11 a-l Y1=Yes. Increases in all categories Y2=Yes. All categories	Q 22 Y1=Yes. Increases in 11 of 17 categories. Y2=Yes. All 17 categories	Increased use of Internet research, blogs, & Wikis.	Q 19 Yes. CFF Teachers used 6 of 8 categories more than non-CFF teachers
10. What instructional strategies are used in CFF classrooms?	Q 9 a-l Y1=Yes. Y2=Yes. Decrease in value of lecture & increase in student-centered strategies.		Q 23 Y1=Yes. Y2=Yes. Decrease in use of lecture & increase in student-centered strategies.	Increased use of learner-centered strategies.	
11. Do the instructional strategies used by CFF teachers appear to change in ways supported by the TPR's five research-based domains?			Y1=Yes. Increases in 2 of 5 domains Y2=Yes. Increases in all 5 domains.		
12. Is there a difference in the attention paid to "21st century skills" in CFF classrooms?	Q2e Y1=NSD Y2=Yes. More attention paid to 21st century skills.	Q1 Y1=Yes. Y2=Yes. Stronger agreement that school develops work skills.	Q 27 Y1=Yes. Increases in 10 of 12 domains. Y2=Yes. Increases in 9 of 12 domains.	Students are developing 21st century skills.	

Table ES-2: Summary of Findings Related to Student Activity

Impact on Student Activity	Teacher Surveys	Student Surveys	CFF Classroom Observations	CFF Leader Interviews
1. Has CFF changed the level of student engagement?	Q7 Y1=NSD Y2=Yes More Engaged	Q5 Y1=Yes Y2=Yes Small, but significant changes in interest in the topics taught -- in the wrong direction.	Q 4, 9, 14 Y1=NSD for % Engaged, YES, for Level of Engagement. Y2=Yes for both % (last 1/3) and level (all thirds)	CFF leaders report increases in student engagement.
2. Has CFF changed percentages of time students are...				
Listening to the teacher (in a large group setting)	Q10a Y1=NSD. Y2=Yes. Less time.	Q6a Y1=Yes, but to middle. Y2=Yes. Less time.	Q27a Y1=Yes. 12% less. Y2=Yes. 13% less.	CFF leaders report less time spent in lecture.
Listening to other students (in a large group setting)	Q10b Y1=Yes. More Time Y2=Yes. To middle.	Q6b Y1=NSD. Y2=Yes. Slightly less time.	Q27b Y1=Yes. 8% less. Y2=NSD.	
Working independently	Q10c Y1=NSD (Close) Y2=Yes. To middle.	Q6c Y1=Yes. More Time. Y2=Yes. More, but very small.	Q27c Y1=NSD. Y2=NSD. (but close)	
Working in groups	Q10d Y1=Yes. More Y2=Yes. More	Q6d Y1=Yes. Toward middle. Y2=Yes. More, but very small.	Q27d Y1=NSD. (but close) Y2=NSD. (but close)	
Talking with the teacher in 1-to-1 or small group conversations	Q10e Y1=NSD Y2=Yes. More	Q6e&f Y1=Yes. More Time. Y2=Yes. More, but small.	Q27e Y1=NSD. Y2=NSD. (but close)	
Off Task	Q10f Y1=NSD Y2=Yes. Less time off task.	Q6g Y1=Yes. More Time (off task). Y2=Yes. More time off task.	Q27f Y1=Yes. 2% less off task. Y2=NSD.	CFF leaders report less off task behavior.

Impact on Student Activity (continued)	Teacher Surveys	Student Surveys	CFF Classroom Observations	CFF Leader Interviews	PATI Survey
3. In CFF classrooms, how much time do students spend using computers?	Q10g Y1=Yes. Students spend more time with tech. Y2=Yes. Students spend more time with tech.	Q6h Y1=Yes. Students spend more time with tech. Y2=Yes. Students spend more time with tech.	Q26 Y1=Yes. 29% fewer used tech not at all, and 18% more used tech almost the entire period. Y2=Yes. 16% fewer used tech not at all, and 27% more used tech almost the entire period.		Q12 Y2 = YES. CFF students spend more time with tech than non-CFF students do.
	(However, at the end of Y2, 39% of teachers report that their students spend only 0% to 20% of their time using computers.)				
4. Does CFF change the type of products on which students' grades are based?	Q11a-g Y1 & Y2 = Yes. More grading emphasis on reports, presentations, projects, & group work. In Y2, less on tests & quizzes.	Q7a-h Y1 & Y2 = Yes. More grading emphasis on reports, presentations, independent projects, & group projects. In Y2, less on tests & quizzes.	Q18 Y2=Yes. Students are more likely to be: <ul style="list-style-type: none"> • working on a clearly defined task • able to demonstrate learning in a variety of ways • choose products based on interests • assessed using a clear rubric • choose whether to work independently or in groups, and • allowed to work at their own pace. 		

Table ES-3: Summary of Findings Related to Teacher Attitudes

Impact on Teacher Attitudes	Teacher Surveys	PATI Survey
1. Do teachers' opinions about the potential value of technology in their classrooms change during their CFF experience?	Q8r, Q12 Y1=NSD (but close) Y2=YES Technologies increased in value. 10% more teachers said technologies were "very valuable" in their classes.	
2. Do teachers believe that the quality of the learning experience they offer has increased as a result of CFF?	Q13 Y1=Yes. Y2=Yes. Teachers believe the quality of education is better.	
3. Do teachers believe student learning has increased as a result of CFF?	Q14a Y1=NSD. Y2=Yes. Teachers tended to agree more strongly that learning has increased as a result of CFF.	
4. Does CFF change the type of work they assign and the quality of work they expect from students?	Q14b Y1=Yes. Y2 = Yes. Teachers expect higher quality work.	
5. Do teachers develop more technology-related skills and feel better prepared to teach using technology?	Q14c, Q14g Y1=NSD (but close) Y2=Yes. Teachers agree more strongly that they have the tech skills they need (strong), and feel better prepared to teach than they did last year.	Q19-A-3 Y2=Yes. CFF teachers are far more comfortable teaching with technology than their non-CFF peers.
6. Do teachers believe that they are working longer or harder as a result of CFF?	Q14d, Q14e Y1=NSD. Y2=Yes. Working harder? Very small changes, but over 70% agree. Working longer? More likely to agree or strongly agree, as 63% did.	
7. Does CFF change the way teachers feel about teaching as a profession?	Q14f Y1=NSD Y2=NSD	
8. How important do teachers believe the CFF Coaches to be in the success of CFF?	Q15i Y1=Yes. Y2=Yes. 76% feel the coach is either valuable or very valuable, and this increases through the school year.	
9. Which of the CFF Coach responsibilities do the teachers perceive as most important?	Q15a - Q15h Significant differences were caused primarily by teachers moving out of the "not applicable" category as the year moved on. Most important are: 1) suggesting ways to incorporate technologies to teach content 2) teaching teachers to operate computers, networks, and software, and 3) providing professional development.	
10. How important do teachers believe the principal has been in the success of CFF?	Q16f Significant differences were caused primarily by teachers moving out of the "not applicable" category between pre and post. Some principals are very valuable, others are not at all valuable.	
11. Which of the principal's contributions do the teachers perceive as most important?	Q16a - Q16e Most important are: 1) Observing their instruction and providing feedback, and 2) Suggesting ways to incorporate technologies to teach content.	

Table ES-4: Summary of Findings Related to Student Attitudes

Impact on Student Attitudes	Student Surveys
1. Do students believe that the quality of the learning experience offered has increased as a result of CFF?	<p>Q1 Y1=Yes Y2=Yes Almost 3/4 of CFF students either agree or strongly agree that school is helping them build skills that will lead to success in the modern workplace.</p> <p>Q8o Y2=Yes, but... 5% decrease between pre and post, with 56% agreeing or strongly agreeing that school is providing them with a quality education.</p>
2. Do students' opinions about the value of school change as a result of their CFF experience?	<p>Q8b Y1&Y2=Mixed. Small changes. 48% are proud of their school.</p> <p>Q8c Y1&Y2=Yes. Small changes. Students are slightly more excited about school.</p> <p>Q8d Y1&Y2=No. Students report putting slightly less effort into school on the post surveys.</p>
3. Does student interest in math, science, language arts, and social studies increase as a result of CFF?	Q9 Y1=NSD. Y2=Yes, but very small changes.
4. Does CFF influence students' perceptions of their preparation for college and for life after school?	<p>Q8 f,g,h Y1=Yes, but very small changes.</p> <p>Y2=Yes, but very small changes.</p> <p>2% increase in students who strongly agreed that they felt ready for the real world with reference to their technology skills.</p>
5. Does CFF influence students' interest in teaching as a career?	<p>Q8 i,j Y1&Y2=Yes.</p> <p>Students are more likely to consider teaching as a profession, and are more likely to believe that it would be fun to teach math or science.</p>
6. Do students believe that they are working longer or harder as a result of CFF?	<p>Q8 k,l,m,n</p> <p>Y1&Y2=Yes, but generally small shifts and generally toward neutral.</p>

Table ES-5: Summary of Findings Related to 21st Century Skills

21st Century Skills Investigation	Measurement Tool	Findings
Creativity	Torrance Tests of Creative Thinking	<p>CFF students outperformed Control in:</p> <ul style="list-style-type: none"> • Elaboration and • Resistance to Premature Closure <p>Control students outperformed CFF in:</p> <ul style="list-style-type: none"> • Fluency and • Abstractness of Titles.
Formal Thinking	Arlin Test of Formal Reasoning	No Significant Difference (NSD)
Teamwork	Teamwork Rubric	No Significant Difference (NSD)
Group Problem Solving	Ruler	No Significant Difference (NSD)
Product Quality	Presentation Rubric	<p>CFF students outperformed Control in:</p> <ul style="list-style-type: none"> • Use of Sources <p>Control students outperformed CFF in:</p> <ul style="list-style-type: none"> • Mechanics
Presentation Skills	Presentation Rubric	<p>CFF Students outperformed Control in:</p> <ul style="list-style-type: none"> • Body Language
Self-Directed Learning	Content Test on Research Topic	No Significant Difference (NSD)

Conclusion: It is still very early in the CFF initiative, but there are definite signs that all involved understand that CFF is about new approaches to instruction and learning (not technology), and there is evidence that positive changes are underway. The benefits of these changes will develop over the coming years, as more teachers get involved with CFF, as teachers develop new strategies for using the technologies to simultaneously deliver their content and to develop higher order skills, and as the gains students make compound over a series of courses and teachers who are using CFF equipment and the new approaches they make possible.

Section 1: Classrooms for the Future Overview

About Classrooms for the Future

The purpose of the Classrooms for the Future (CFF) initiative is to transform Pennsylvania's high schools, making them more engaging and more responsive to the economic challenges presented by globalization. This high school reform initiative is at the same time an effort to enhance teaching and learning, to promote access to technology and the effective use of that technology, and to increase our ability to compete in an increasingly global marketplace. As such, this reform initiative targets both increasing the number of powerful computers available for student use (a laptop computer on every student desk in every public high school classroom in which the four core subjects are taught) and the professional development of teachers (a multimedia teaching station in each classroom and the preparation required to use these technologies well).

CFF leaders believe that by adding technology access for students and teachers and by making a significant commitment to the professional preparation of teachers to use these resources well, this initiative will change teaching methods, improve student interest and engagement, and improve learning of academic content and the development of "21st century skills." On September 20, 2006, Governor Edward G. Rendell proposed that, "Classrooms for the Future will not only help to boost achievement while our students are still in high school, but they will be primed for success in college and beyond, especially in fields that require advanced skills with computers and technology" (Rendell, 2006). Further, Governor Rendell proposed that measures of statewide technology access and use, such as those offered by *Education Week (Technology Counts, 2006)*, will reflect the change, but that more importantly, "this initiative is about enhancing our schools' learning environment, increasing student achievement and preparing our students to compete in the global job market" (Ibid.). More detail on the CFF initiative can be found in Appendix A.

In the first year of the CFF program, within the 2006-2007 budget, Governor Rendell committed \$20 million to Classrooms for the Future (Philips & McDonald, 2007, p.1). In that first year 103 schools in 79 districts were selected to be part of the initial wave of the program (Barnes, 2006). Over the next two years, an additional \$180 million was to have been allocated so that every high school in Pennsylvania would have an opportunity to participate. In the 2007-2008 budget year an additional \$90 million was allocated, and an additional 224 districts were added, bringing the total to 6810 teachers, and 303 districts that are the subject of this report.

The Role of Professional Development in the Program

Research shows that teachers tend to teach as they have been taught (Goodlad, 1990) and that effective, ongoing professional development is required if a reform is to result in important changes in teaching behaviors (Richardson, 2003). Professional development is acknowledged by CFF leaders as the key to success for the Classrooms for the Future

program. There are three pillars to the professional development offered by the CFF program:

- Participation in a minimum of two days of real time training
- Participation in a minimum of 30 hours of additional professional development on PDE-mandated content through a combination of offline and online course work training per year
- Use this professional development experience to integrate the technology appropriately by adopting practices that regularly integrate technology with teaching and learning (CFF Handbook, 2008-09).

All applicants agree to participate in these professional development activities, designed for leaders, coaches, and teachers.

Instructional Technology Coaches involved in CFF are hired to work with classroom teachers as they integrate instructional technology into their classrooms. All coaches are required to complete a training program, the ultimate goal of which is to enable teachers to employ effective strategies and multiple technologies to reach all students and enhance their learning (CFF Handbook, 2008-09). The coach's role in the CFF program has been seen as invaluable in creating an environment where teachers can feel comfortable with the technology, supporting teachers in exploring new ways of teaching, and helping teachers to actively engage students in learning. According to the principals, project managers, and technology directors interviewed, the coaches are critical to the success of the program. Words describing the coach in the interviews included: invaluable, outstanding, indispensable, instrumental, catalyst, and critical. One project manager explained the coach's role, saying, "The coach is the success of all of this. Having a coach who is a teacher is the ideal experience because they are the ones on the front edge; they are on the cutting edge of integrating this technology into the lessons. And then they serve as a model for other teachers as well as the facilitator of other teachers to try different instructional processes. So the coach has been crucial to all of this." Another noted that, "Our coach is invaluable. She has been an unbelievable help to the teachers. She is one of the best resources to ever come out of any grant or program ever."

Overview of the CFF Evaluation

This CFF Evaluation Report strives to document, in a comprehensive way, what CFF has achieved. Between Years One and Two, the CFF Evaluation Team implemented a tracking system that monitored completion of surveys and observations, which dramatically improved data collection.

While the purpose of this year's report is the same, the look of this year's CFF annual report has changed. While still sequentially addressing each of the core research questions, we provide comparisons between Year One and Year Two data for the surveys and the observations, in conjunction with results from the Year Two interview process, which included coaches, principals, and project managers, as in Year One, but also included 30 CFF technology directors. To expand the content and keep the report from

becoming overly burdensome, we have adopted less of a narrative format and more of a tabular format designed to help readers find and understand the results quickly. Much of the detail on methodology and statistical analyses work is relegated to Appendices for this reason.

As in the Year One report, our evaluation team was asked to conduct research that investigates seven core research areas:

- The impact of the CFF initiative on teaching practice
- The impact of the CFF initiative on student activity
- The impact of the CFF initiative on teacher attitudes
- The impact of the CFF initiative on student attitudes
- Factors that may be enhancing or limiting the initiative impact
- The impact of CFF initiative on student achievement
- The impact of the CFF initiative on the development of 21st Century Skills

The nature of this multi-faceted evaluation is both formative and summative. As a formative evaluation, this report strives to document the effects of CFF on today's schools, from the perspective of a "work in progress." The results contained can be, and should be, used to guide professional development efforts and to improve the program and enhance its effectiveness. As a summative evaluation, this report puts Year Two of the CFF initiative in the spotlight, and reports to policymakers and the general public about the extent to which the program appears to be achieving its short-term goals.

More detail on the CFF Evaluation, its methodology, and its limitations can be found in Appendix B.

Section 2: Impact on Teaching Practice

In our early discussions with the Pennsylvania Department of Education, the expectations for the CFF program were discussed and the underlying belief was proposed:

“CFF will change how teachers teach, which, will change how students learn, which will, ultimately, affect student achievement.”

Based on this proposition, our research questions look first at the degree to which the new technologies are present and used in the classrooms and then at teacher activity, to see how it changes across the academic year.

This section is a summary of the 12 research questions related to technology access, technology use, and teacher activity:

1. Has CFF impacted the amount of technology access for teachers?
2. Has CFF changed classroom layout (arrangement of desks, etc.)?
3. Has CFF changed the percentage of time teachers spend lecturing and in other activities?
4. Has CFF changed the "complexity" of class content, moving from "basic skills" to more "higher-order" topics?
5. Has CFF changed the "instructional style" exhibited by the teacher, on a scale from "didactic" to "constructivist"?
6. Has CFF changed the "relevance" of class content, moving from "artificial" to more "real world" in nature?
7. What technologies are being used in the different subject areas, and how is this changing as a result of CFF?
8. Are teachers experiencing any changes in classroom management (discipline problems, time lost in transitions, etc.) as a result of CFF?
9. Are teachers comfortable teaching in CFF classrooms?
10. What different software applications are being used in CFF classrooms?
11. What instructional strategies are used in CFF classrooms?
12. Is there a difference in the attention paid to "21st century skills" in CFF classrooms?

The evidence gathered for each question is provided on the pages that follow.

Observations Year One and Year Two (Q2)

Changes in Access to Technology

	Year One			Year Two		
	Pre (N=124)	Post (N=124)	Change	Pre (N=124)	Post (N=124)	Change
Teacher has access to computer	93%	100%	7%	92%	97%	5%
Presentation station is available (projector, speakers)	52%	73%	22%	45%	74%	28.8%
Electronic whiteboard is available	23%	81%	59%	53%	93%	41%
1 student per computer	29%	66%	37%	29%	77%	49%
2 students per computer	0%	4%	4%	1%	2%	1%
3-5 students per computer	3%	1%	-2%	2%	3%	1%
More than 5 students per computer	18%	8%	-10%	16%	5%	-10%
Internet access is available to all computers	83%	94%	11%	78%	90%	12%

Observations Y1 and Y2 Compared

Access to technologies increased significantly in both Years One and Two. It is interesting to note, however, that even at the post observation point only 79% of classrooms observed in Year One and 84% of classrooms in Year Two provided any level of student access to computers. (See Table Q26, Appendix E, page E-15.) One-to-one access to computers was less common, with only 66% of observed classrooms at this level by the post observation in Year One and 75% at one-to-one access by the end of Year Two. (See Table Q1, Appendix E, page E-1.) This is probably due to the fact that many CFF classrooms share access to the computers, which are generally laptops on carts, with teachers in other rooms.

Another interesting point of comparison is the penetration of electronic whiteboards in classrooms. The higher percentage change in Year One is a function of the low starting point in Year One, and the higher starting point in Year Two is no doubt a function of Y1 installations. The important statistic here is that penetration by the end of Year Two has reached 94% of CFF classrooms. (See Table Q1, Appendix E, page E-1.)

Conclusion

Technology access has increased dramatically in the two years that CFF has been in operation. However, the implementation is still far from the original vision of a laptop on every student desk. Shared access to laptops is common, and the impact of the program is likely to be affected by this.

Has CFF Changed Classroom Layout?

Survey Year One

Teacher Survey (Q1):

Teachers reported that more classrooms were arranged as small clusters of desks (up 4% to 18%) ($\chi^2 = 13.31$, $p = .009$).

Survey Year Two

Teacher Survey (Q1):

Teachers reported that fewer classrooms with desks in rows (down 7% to 62%), meanwhile more students were sitting in smaller clusters of desks (up 4% to 17%) and other configurations ($\chi^2 = 67.51$, $p < .001$).

Survey Y1 and Y2 Compared

Teacher Survey (Q1):

Teacher Survey responses from both Years One and Two indicate changes in classroom configuration toward an increase in the number of classrooms using small clusters of desks.

Observations Year One (Q2)

Observers noted that fewer classrooms (15%) were arranged as desks in rows, and more (10%) were arranged in small clusters of desks, and other configurations. ($p < .005$).

Observations Year Two (Q2)

Observers noted that at the post observation 5.3% more were arranged in small clusters of desks. However a much smaller reduction was noted in the number of classrooms arranged as desks in rows (2.4%). Changes in other configurations were all 1.5% or less.

Observations Y1 and Y2 Compared

Classrooms for the Future does appear to affect classrooms configuration, with a decrease of rooms configured as desks in rows and an increase in the number of classrooms configured as small clusters of 3 to 5 desks, but the changes in Year One of the program appear to have been more numerous than in Year Two.

Y2 Conclusions

Classrooms for the Future is changing the layout of the classroom, reducing the number of classrooms arranged as desks in rows, and increasing the number of classrooms featuring small clusters of three to five desks. In conversations with educators about this finding, most suspect that this has been done to promote student collaboration, although another reason might be access to electrical power.

Has CFF Changed the Percentage of Time Teachers Spend Lecturing and in Other Activities?

CFF Survey Year One

Teacher Survey (Q2a-f):

Teachers did not report spending significantly more or less time engaged in whole group lecture or instruction, whole class discussion, working with small groups, working with individuals, or observing or interacting with students, but they did report spending more time at their desks working ($p < .001$).

Student Survey (Q2a-e):

Students also noted that teachers appear to spend more of their time working with small groups of students ($p < .001$) and with individuals ($p = .014$).

CFF Survey Year Two

Teacher Survey (Q2a-f):

Teachers reported spending less time on whole group lecture ($p < .001$) and more time working with small groups of students ($p < .001$) and working with individual students ($p < .001$).

Student Survey (Q2a-e):

As was the case in Year 1, students reported that teachers appear to spend more of their time working with small groups of students ($p < .001$) and with individuals ($p < .001$).

CFF Survey Y1 and Y2 Compared

The differences noted between the teachers reports in Year One and Year Two may be due to the fact that contracting and implementation delays in Year One may have shortened the time they had with the new teaching environment, which may have limited the time they had to transition to the types of activity exhibited in Year Two. This difference may also reflect the effects of coaching by the CFF coaches, the building principals, or other collaborators.

Observations Year One (Q3)

Statistically significant changes were observed across each third of the class period, including less time spent in whole group lecture and more time spent working with small groups and individual students.

Observations Year Two (Q3)

The Year Two observations also noted significant changes in the ways teachers spent their time, but only in the second and final thirds of the class period. As in Year One, there was a significant reduction in the amount of time spent in lecture, which was down 13% in both the second and last thirds of the class. Significantly more time was spent working with individuals in the second third of the class (6.5%) and working with small groups of students in the final third of the class (6.2%).

Observation Y1 and Y2 Compared

The same patterns were noted in Year One, a decrease in the amount of time spent in lecture and an increase in time spent with individual students and small groups of students. However, these findings spanned all thirds of the class session in Year One, and were found only in the second and final thirds of the class session in Year Two.

CFF Interview Results

Numerous Principal comments (39%) indicated that the main focus of the CFF program was engaging students in a more interactive learning environment. Nearly as many principals (37%) reported that they have seen more active learning, more student participation, and more collaboration among students. Principals also reported changes in the ways students are learning, changes in the ways teachers are teaching, and changes in the ways content is being presented: “The way that students are learning has changed so much. The CFF program has helped reach them better. [CFF] caused teachers to change their teaching styles to better reach the kids in the way they want to learn.” The project managers interviewed observed similar changes in classroom practice. In their responses, 51% identified more student-focused activities, more student interest and engagement (21%), and a deeper level of teacher engagement (18%). One project manager described the changes, saying “I had worked with him [a veteran teacher] in years past, and he would have rose straight up and down all the time and lecturing. And now he has students in a circle and has much more conversation. He is using the Promethean board. Yes, he is risk taking. He wouldn’t do this in the past.” He continues, “I see other teachers doing more than what I would have expected. And I’ve been in the district for a long time, so I do see teachers improving and trying new things.”

Y2 Conclusions

There is considerable evidence, crossing the surveys, observations, and interviews, that indicates that CFF is changing how teachers teach, as indicated by the time they spend in different teaching activities. Teachers are devoting less time to lecture and whole group instruction, and more time to working with small groups of students and individual students.

Has CFF changed the "instructional style" of the teacher, on a scale from "didactic" to "constructivist?"

CFF Survey Year One

Teacher Surveys (Q4):

Teachers report no statistically significant changes ($p=.654$)

Student Surveys (Q4):

Student survey responses from year one also give insight into an apparent shift in teaching style. Between the pre and post surveys in year one students reported significant reductions in the percentage of teachers who: determined all of the topics to be studied (from 60% to 55%); controlled the way in which topics were studied (from 32% to 28%); controlled whether students work together or alone (from 34% to 30%); controlled the specific topics of papers or assignments (from 54% to 47%); and controlled the criteria for grading assignments (from 77% to 69%).

Observations Year One (Q6, 11, 16)

Across each third of the class period, trained observers noted that teachers used a more constructivist teaching style ($p < .001$). Combining the three thirds of the class, the change involved a shift of .87 points, from 3.27 (pre) to 4.14 (post) on a seven-point scale.

CFF Survey Year Two

Teacher Surveys (Q4):

Teachers describe that their teaching style is less didactic, and more constructivist, with a shift of approximately 3% from the didactic end of the scale toward the constructivist end. ($p=.008$)

Student Surveys (Q4):

Student survey responses from Year Two reflected some of the same pre/post shifts in teaching style. Students reported significant reductions in the percentage of teachers who: determined all of the topics to be studied (from 64% to 60%); controlled the specific topics of papers or assignments (from 55% to 51%); and controlled the criteria for grading assignments (from 76% to 72%).

Observations Year Two (Q6, 11, 16)

As in Year One, across each third of the class period, observers noted that teachers used a more constructivist teaching style ($p < .001$). Combining the three thirds of the class, the change involved a shift of .78 points, from 3.64 (pre) to 4.42 (post) on a seven-point scale.

CFF Survey Y1 and Y2 Compared

Teacher Surveys (Q4):

The differences in the year two and the year one findings from the teacher surveys may reflect progress, but not much.

Student Surveys (Q4):

Students seem to indicate that more progress is being made than teachers, but this may be because the items in the student survey were designed to elicit information about aspects of teaching style that were not prompted for in the teacher survey. Teachers made a more holistic judgment on a scale from didactic to constructivist, and may not have been considering the same factors as students in that determination.

Observation Y1 and Y2 Compared

The results are consistent across Years One and Two: CFF teachers moved toward more constructivist practices.

CFF Interview Results

Principals, project managers, and technology directors have reported seeing more student-centered classrooms. When asked about changes in classroom practice, 51% of project managers' responses described classroom activities as more student focused. They also reported seeing more student interest and engagement (21%). Principals (22%) have noted that the teacher is more of a facilitator in the classroom and that they are seeing more active learning and student participation (37%), as well as more differentiated instruction (8%). Principals have also suggested that the professional development activities and the coach have helped teachers change their teaching style by actively involving the teachers in the process. One project manager reports that changing from a teacher-centered to student-centered environment is an ongoing process in terms of helping teachers move away from direct instruction to be more of a facilitator. He reports that he is transitioning teachers away from, "Let's open the book to page 52" and being worried about getting to page 300 in the textbook, to identifying ways to incorporate "real-life relevance" and its' application to learning. Another project manager described a "very traditional teacher-led discussion instructional model with students engaged to some extent" that has developed into a "much more dynamic classroom." He described it as seeing "much more collaboration going on, not only from teacher to student but student to student."

Y2 Conclusions

Differences between what teachers report and what observers see may be due, in part, to the fact that the observers were trained to recognize the difference between the didactic classrooms and constructivist approaches. Given the survey data moving in the direction of the observers' and students' reports, it seem safe to conclude that progress is being made here – teachers are moving toward more constructivist teaching practices. However, the leaders of the program may wish to assess whether the pace at which things are changing (about .825 points per year on a seven-point scale) is appropriate or whether additional coach and professional development time should be invested in this area.

Has CFF Changed the "Complexity" of Class Content, Moving from Basic Skills to More Complex Topics?

CFF Survey Year One

Teacher Survey (Q3):

There was no statistically significant change in teachers' perceptions of the "complexity" of their class content ($p=.602$).

Student Survey (Q3):

Students reported small but significant differences when asked about how much time they spend in really complex thinking and problem solving. On the post survey 2% more students (13%) reported that their classes spend almost all of the time in such activity. Thirty-nine percent reported that their classes spent either "quite a lot" or "almost all" of the time engaged in such activity ($p < .001$).

CFF Survey Year Two

Teacher Survey (Q3):

Teachers reported a small, but statistically significant shift in the complexity of the content in their classes, toward increased focus on higher-order skills. On the pre survey, 30% reported that their classes were more about content knowledge than higher-order skills, and on the post survey that number had dropped to 26% ($p < .001$).

Student Survey (Q3):

Students reported small but significant differences when asked about how much time they spend in really complex thinking and problem solving, but in a negative direction. Between the pre and post surveys the number of students reporting that their classes spent either "quite a lot" or "almost all" of the time engaged in such activity dropped from 40% to 38% ($p < .001$).

CFF Survey Y1 and Y2 Compared

Teacher Survey (Q3):

Data from the teachers surveys in Year One and Year Two seem to be indicating that progress is being made.

Student Survey (Q3):

Data from the student survey seems to contradict the small change reported in teacher surveys in Year Two.

Observations Year One (Q 5, 10, 15)

Observers noted that the complexity of class content changed, indicating more activity involving higher-order skills across each third of the class period ($p < .001$). Combining the three thirds of the class, the change involved a shift of .76 points, from 3.62 (pre) to 4.38 (post) on a seven-point scale.

Observations Year Two (Q 5, 10, 15)

As was the case in year one, observers noted that the complexity of class content changed indicating more activity involving higher-order skills across each third of the class period ($p < .001$). Combining the three thirds of the class, the change involved a shift of .64 points, from 4.13 (pre) to 4.76 (post) on a seven-point scale.

Observation Y1 and Y2 Compared

The results of the observations are consistent. CFF is resulting in more activity involving higher-order skills.

CFF Interview Results

When asked about the most valuable aspect of the CFF program, 39% of principals mentioned that the addition of technology, coupled with new teaching methods, guides student learning to a higher level. One principal described it this way: “When talking to students about the different things they are doing in a classroom—like utilizing wiki space, music from the 1920s, or the war—they are using higher-order thinking skills which provides a higher level of engagement.”

Y2 Conclusions

While the data from class observations indicates that progress is being made and that classes are now more focused on complex thinking and the development of higher-order skills, data from teacher and student surveys is less promising. It could be that the observers are seeing the teachers' best lessons, or that the randomly selected teachers being observed are not, despite the randomization, representative of the larger teacher population. It could also be that the observers, who were trained to conduct these observations, have a different view of higher-order skills than the teachers and students. Our belief is that progress is being made, but that additional attention to the development of higher-order skills and complex thinking would be beneficial.

Has CFF Changed the ‘Relevance’ of Class Content?

CFF Survey Year One

Teacher Survey (Q5):

Teacher survey results indicate a significant ($p=.015$) shift from assignments that are submitted to the teacher only to projects that resemble what people do outside of school. On the pre survey 63% of teachers chose the two options on the "teacher only" end of the scale, while on the post surveys only 56% chose these (a shift of 8%).

CFF Survey Year Two

Teacher Survey (Q5):

As in Year One, teacher survey results indicate a significant ($p < .001$) shift from assignments that are submitted to the teacher only to projects that resemble what people do outside of school. On the pre survey 62% of teachers chose the two options on the "teacher only" end of the scale, while on the post surveys only 56% chose these (a shift of 6%).

CFF Survey Y1 and Y2 Compared

Nearly identical results from Years One and Two indicate a stable finding that a shift is occurring with assignments becoming more like what people outside of school do.

Observations Year One (Q 7, 12, 17)

Across each third of the class period, trained CFF observers found that during the post observation period students were more likely to be in a learning activity that was more like "authentic" real world projects than "artificial" school-directed activity ($p<.005$). Combining the three thirds of the class, the change involved a shift of .67 points, from 3.54 (pre) to 4.21 (post) on a seven-point scale.

Observations Year Two (Q 7, 12, 17)

As was the case in Year One, across each third of the class period, trained CFF observers found that during the post observation period students were more likely to be in a learning activity that was more like "authentic" real world projects than "artificial" school directed activity ($p<.001$). Combining the three thirds of the class, the change involved a shift of .64 points, from 4.12 (pre) to 4.77 (post) on a seven-point scale.

Observation Y1 and Y2 Compared

The results of the observations are consistent across Years One and Two. CFF is contributing to a shift toward assignments that are more "authentic" (representative of what goes on outside of school).

CFF Interview Results

Principals have seen changes in class content facilitated by having technology tools that extend students' learning experiences outside the classroom. One principal stated, "Technology in the classroom allows students to use real life situations and knowledge of the technology that they may have in the future whether at a job or in their future with college." Another principal noted, "Students understand a connection to the world."

Y2 Conclusions

The evidence across surveys and observations, across years one and two lend strong support for the premise that teachers are changing the assignments they give to make them more like what people do outside of school and less like artificial, school-oriented assignments completed for the teacher's eyes only. However, there is room for continued growth in this domain, as the means are still below five on a seven-point scale.

What Technologies are Being Used in the Different Subject Areas, and How is This Changing as a Result of CFF?

Observations Year One (Q21, 24)

Observers noted which technologies were being used over the course of the observation. Teacher use of laptops during the lesson had increased by 33% to 65% from the pre to post observation period, and students use had increased by 31% to 42%. Teacher use of calculators and TV/VCR technologies were down 2% and 6% respectively, while student use of calculators increased by 2% and student use of TV/VCR technologies decreased by 4%. Teacher use of cameras and LCD projectors increased by 11% and 20% respectively, while student use of both cameras and LCD projectors increased by 6%.

Observations Year Two (Q21, 24)

Teacher use of laptops during the lesson had increased by 37% to 74% from the pre to post observation period, and student use had increased by 42% to 62%. Teacher use of calculators and TV/VCR technologies were down 1% and 3% respectively, while student use of calculators changed very little, and student use of TV/VCR technologies increased by 5%. Teacher use of cameras and LCD projectors increased by 6% and 28% respectively, while student use of these technologies increased by 5% and 10% respectively.

Observation Y1 and Y2 Compared

Year Two results show a better percentage of student use of laptop computers, but that percentage is still lower than one might expect (62%).

At the end of Year Two, about three-fourths (74%) of the teachers used a laptop computer during the lesson, and about two thirds (67%) used an LCD projector.

CFF Interview Results

One of the most used technologies in the classrooms is the interactive whiteboards provided by CFF. One project manager commented, "I think the teachers have been more engaged using the interactive whiteboards, which has caused the students to have an increased level of involvement in the educational process. They have a sense of excitement that they are using some new and current technology." The interactive whiteboards are used by different teachers in different ways. One principal found that teachers were requesting to use the whiteboard who were not part of the initial CFF program. He reported, "I think I'm going to have some teachers get into a fist fight on who can use the whiteboard. I've had teachers who aren't part of CFF asking if they can use the equipment. You are going to have those that move far ahead and some shuffling along but everyone is reacting very positively about it." Another principal mentioned that, "They are using smartboards and projectors more. They are using them for different transitions in the classroom. Introduce a topic for 15 minutes and then switch over to computer, and then students looking up the information on computer. More meaningful transitions in the classrooms."

Y2 Conclusions

Classrooms for the Future is significantly increasing access to technologies in the classroom, and teachers and students are taking advantage of this increased access. The small number of observations does not allow us to define differences in use that may exist between teachers of different academic subjects.

Are Teachers Experiencing Any Changes in Classroom Management as a Result of CFF?

<p style="text-align: center;"><u>CFF Survey Year One</u></p> <p>Teacher Survey (Q14h): No significant pre/post differences were reported by teachers in Year One. Approximately 75% of teachers either agreed or strongly agreed with the statement, "Students in my classroom are generally well behaved and do what they are asked to do."</p>	<p style="text-align: center;"><u>CFF Survey Year Two</u></p> <p>Teacher Survey (Q14h): As in Year One, no significant pre/post differences were reported by teachers in year two. Approximately 76% of teachers either agreed or strongly agreed with the statement, "Students in my classroom are generally well behaved and do what they are asked to do."</p>	<p style="text-align: center;"><u>CFF Survey Y1 and Y2 Compared</u></p> <p>Teacher Survey (Q14h): Results from Years One and Two are consistent. Teachers report no change in classroom management as indicated by student behavior.</p>
<p style="text-align: center;"><u>Observations Year One (Q19)</u></p> <p>Statistically significant pre/post differences ($p=.000$) indicate that classroom management, which appeared to be quite good during the pre observations (91% of classes were rated as either good or excellent), got significantly better by the post observations, with an increase of 15% rated as excellent, and a total of 95% rated as good or excellent.</p>	<p style="text-align: center;"><u>Observations Year Two (Q19)</u></p> <p>Pre/post observations were not significantly different. As in Year One, ratings of classroom management were quite good, both pre (91% rated as good or excellent) and post (92.4% rated as good or excellent). There was an increase of 6.1% rated as excellent at the post assessment.</p>	<p style="text-align: center;"><u>Observation Y1 and Y2 Compared</u></p> <p>Classrooms management was rated quite high in both Years One and Two. And progress was made between the pre and post observations in both years.</p>

CFF Interview Results

Technology directors and project managers found that teachers were able to more quickly implement their lessons as a result of CFF primarily due to the availability of the laptops, eliminating lost time going to a computer lab. In addition, students who were apathetic about school are now being engaged in ways that are exciting for them. Interview data also indicated that as a result of the change in classroom environment, discipline problems have been reduced. Project managers reported that teachers say they are "seeing fewer behavior issues, better attendance, and more homework turned in by students who traditionally were not engaged."

Y2 Conclusions

Despite fears to the contrary, CFF classrooms actually experience very few management issues, with approximately 60% of classes rated as excellent, 34% rated as good, 6% rated as fair, and less than 1% of classrooms rated as poor at the post observation period.

Are Teachers Comfortable Teaching in CFF Classrooms?

CFF Survey Year One

Teacher Survey (Q14i):

No significant pre/post differences were reported by teachers in Year One. However, approximately 92% of teachers either agreed or strongly agreed with the statement, "I feel comfortable and confident while teaching" and another 6% chose "somewhat agree," bringing the total to 98% on the "agree" side of the scale.

CFF Survey Year Two

Teacher Survey (Q14i):

As was the case in Year One, no significant pre/post differences were reported by teachers in Year Two. Approximately 94% of teachers either agreed or strongly agreed with the statement, "I feel comfortable and confident while teaching" and another 5% chose "somewhat agree," bringing the total to 99% on the "agree" side of the scale.

PATI Survey (Q29c):

On a PATI survey item that read, "Teachers are not afraid to learn about new technologies and use them with their class(es)," responses from CFF teachers were not significantly different for CFF and non-CFF teachers. Fifteen percent of CFF teachers strongly agreed, and 64% agreed.

CFF Survey Y1 and Y2 Compared

Teacher Survey (Q14i):

The consistent results from Year One and Two indicate that the vast majority of teachers are quite comfortable teaching with the CFF technologies.

Observations Year One (Q20)

During the pre observation cycle, CFF classroom observers rated 23% of teachers as appearing "fairly comfortable" and 71% as appearing "completely comfortable." During the post observation cycle, **the percentage of teachers rated as "completely comfortable" had risen to 81%.** These changes were statistically significant ($p = .028$).

Observations Year Two (Q20)

During the Year Two pre observation cycle, CFF classroom observers rated 33% of teachers as appearing "fairly comfortable" and 55% as appearing "completely comfortable." During the post observation cycle, **the percentage of teachers rated as "completely comfortable" had risen to 71%.** These changes were statistically significantly different ($\chi^2 = 12.17$, $p = .033$).

Observation Y1 and Y2 Compared

In both Years One and Two, there were significant increases in teacher comfort between the pre and post observations, and high percentages of teachers were either fairly comfortable or very comfortable (98% in Y1, 88% in Y2).

CFF Interview Results

Our interview data indicate that most teachers are very positive and excited about teaching in CFF classrooms and teachers are sharing their successes with other teachers. One project manager reported, “They are absolutely ecstatic and excited. They’re like a kid in a candy store. This technology, the whiteboards connected with the laptops, have so many possibilities with what you can do to present traditional content, to present literature, to present vocabulary, algorithms in math. And you can see the teachers' faces when they’re using the whiteboards; they’re excited as well. They love to use them.” In interviewing principals about teachers’ comfort in the CFF classrooms, they mentioned risk taking and how they were able to facilitate that process by allowing the teachers to try new things without being judged. They report seeing teachers “going outside of the box” and “doing things they would never have tried” before the program. When asked about teacher risk taking, 57% of principals’ responses indicated that teachers were taking risks, and 17% noted that older teachers are teaching differently. An equal percentage (17%) noted that to be successful, teachers needed to be in a non-threatening environment where they were encouraged to take risks.

Y2 Conclusions

Teachers ARE comfortable teaching in CFF classrooms. The comfort level does increase as the year goes on, but this does not appear to be a significant issue, perhaps due to the presence of the CFF coaches and significant investment in professional development.

What Different Software Applications are Being Used in CFF Classrooms?

CFF Survey Year One

Teacher Survey (Q8q-o):

Statistically significant pre/post differences were found on the teacher survey indicating increased use and changes in the reported value of 11 of the 17 computer applications, including:

- Presentation Software
- Other Web-based Learning Activities (including blogs and wikis)
- Web-based digital curriculum or curriculum resources
- Drill and Practice Software, integrated Learning Systems and/or educational games
- Video, graphics, or sound editing/production software (iTunes, iMovie, Garage Band, iDVD, Movie Maker, etc.)
- Desktop Publishing Software (PageMaker, Pages, Publisher, etc.)
- Simulations/Modeling Software
- Other Communications Tools (IM, iChat, discussion boards, videoconferencing)
- Web Publishing software (Dreamweaver, iWeb, etc.)
- Probeware (input devices for gathering data), and
- Database Software (FileMaker, Access)

(See Table 2-1 below for details.)

Student Survey (Q11a-l):

The results of the Year One student survey showed

CFF Survey Year Two

Teacher Survey (Q8q-o):

Statistically significant pre/post differences were found on the teacher survey indicating increased use and changes in the reported value for all of the 17 computer applications.

(See Table 2-2 below for details.)

Student Survey (Q11a-l):

The results of the Year Two student survey also showed significantly more ($p < .001$):

- Word processing
- Software used to learn & practice skills
- Spreadsheet use
- Database use
- Creation and delivery of presentations
- Class-related e-mail
- Online discussion
- Internet research
- Use of tools like graphing calculators and digital microscopes
- Production of print products
- Multimedia reports or projects
- Online tests & quizzes

CFF Survey Y1 and Y2

Compared

Teacher Survey (Q8q-o):

Fifteen of the seventeen software applications surveyed were used by more teachers in Year Two than in Year One. Fewer teachers (4% fewer) used multimedia reference tools, and the percentage of teachers using web publishing software (19%) remained constant over the two years.

There were a number of small shifts in rank in terms of the perceived value of the software applications, as detailed in Table 2-3 below. However, these were exclusively shifts of a single rank, in which two closely valued applications switched positions. In general the applications that were the most popular in Year One were also the most popular in Year Two.

significantly more ($p < .001$):

- Word processing
- Software used to learn & practice skills
- Spreadsheet use
- Database use
- Creation and delivery of presentations
- Class-related e-mail
- Online discussion
- Internet research
- Use of tools like graphing calculators and digital microscopes
- Production of print products
- Multimedia reports or projects, and
- Online tests & quizzes

The vast majority of changes within response categories were small, generally 4% or less. Increases above 4% included:

- An 8% reduction in the number of students who reported never using email to communicate with others about topics they are studying and a corresponding 7% increase of students who "sometimes" do this.
- A 7% decrease in the number of students who never use online discussions and a 5% increase in the number who sometimes do
- A 6% increase in the number of students who sometimes create multimedia reports or projects, and
- A 5% decrease in students reporting the never use online tests and quizzes and a corresponding 5% increase in the number who sometimes do.

As in Year One, the actual changes from category to category were small – generally 4% or less. The only increase above 4% was a 6% reduction in the number of students who reported never using online discussions in class, from 46% to 41%.

PATI Survey (Q19):

On the Pennsylvania Technology Inventory (PATI), both CFF and non-CFF teachers responded to items about their students' technology use. In six of the eight categories, more CFF teachers reported that their students had used or would use the technology.

PATI Tech Use	CFF	Non-CFF	Difference	Sig.
Word Processing	82%	76%	5%	$p < .001$
Presentations	73%	58%	15%	$p < .001$
Electronic Portfolios	8%	10%	-1%	$p = .003$
Video or Audio Products	30%	19%	11%	$p < .001$
Electronic Art	15%	16%	-1%	NSD
Websites	50%	44%	6%	$p < .001$
Modeling (electronic)	16%	9%	7%	$p < .001$
Submissions to Journals	17%	14%	3%	$p < .001$

Statistically significant differences in the patterns of responses were exhibited in 12 of the 17 software application categories, indicating significant changes in the percentage of teachers using them and/or their value as perceived by teachers. Details on these shifts can be found in Appendix C, Table Q8-A-1 to Q8-A17, on pages C-5 through C-10.

Student Survey (11qa-l):

The results from the student surveys were relatively consistent across years one and two, with statistically significant increases in the use of all software categories. However, these increases, although statistically significant, were relatively small, generally 4% or less. However, this may show that teachers are using a several options, each a little more, which may be a good thing. Details on these shifts can be found in Appendix D, Table Q11-A through Q11-L, on pages D-20 through D-23.

	<p>Some of these differences, although statistically significant, are rather small. However, it should be noted that teachers responded positively to the item if even once during the school year their students would engage with the technology. There may be larger differences in the number of times, or the degree to which CFF and non-CFF students use these technologies, and the degree of proficiency they develop.</p> <p>One statistically significant difference of approximately 1% favoring non-CFF teachers in the use of electronic portfolios was found, but it should be remembered that the non-CFF teachers include more art teachers who might use this technology in greater numbers.</p>	
<p><u>Observations Year One (Q22)</u></p> <p>Year One Observers noted a large increase in the percentage of teachers using a laptop computer (up 31% to 65%) and in the percentage of teachers using LCD projectors (up 20% to 52%), as well as a large increase in the number of students using laptops (up 31% to 42%). However, although these increases are impressive, they are not necessarily as high as might have been anticipated, perhaps due to the arrival of the technologies late in the academic year in many schools.</p>	<p><u>Observations Year Two (Q22)</u></p> <p>Year Two Observers also noted a large increase in the percentage of teachers using a laptop computer (up 37% to 74%) and in the percentage of teachers using LCD projectors (up 28% to 67%), as well as a large increase in the number of students using laptops (up 42% to 62%).</p>	<p><u>Observation Y1 and Y2 Compared</u></p> <p>Impressive gains were made in both years, with the percentages of teachers and students using the technologies much higher at the end of year two than at the end of year one.</p>

CFF Interview Results

Interview data indicates that a number of teachers are setting up wikis. They are also using webquests and different presentation styles. One principal found videos and other applications being used with the laptops, stating, “I have definitely seen a lot more PowerPoint incorporated and video clips incorporated into instruction. As you walk down the corridors you can see various things being incorporated through the laptops.”

Y2 Conclusions

Teachers and students have increased access to technologies. As a result of this access and the professional development they have received, the teachers are using all categories of software tracked by this evaluation significantly more than they had before the CFF program was implemented.

Comparisons between CFF and non-CFF teachers are interesting, and they generally show that the CFF teachers are more likely to use most of the software applications with their students, but the data we have from the PATI doesn't really let us compare the frequency of use or the depth of use within an application. The item is worded to capture any teacher whose students use the application, regardless of how many times they use it. We suspect that there are more impressive differences in terms of how often CFF students use each application and the degree of proficiency they develop with it.

The data on levels of use offer CFF leaders an opportunity to consider what might be appropriate levels of use for each application, in a given subject area. It may be surprising to note, for example, that only half of CFF teachers reported that their students would use websites. That may or may not be a desirable level of use, given the fact that math classes may be less likely to use websites, but this is a number that deserves some consideration.

Table 2-1
Summary of Pre/Post Differences in Year One
Teacher Technology Use and Perceived Value of Software Applications


















Year One CFF Teacher Ratings of the Value of Software Applications	Valuable and Very Valuable POST	Very Valuable POST	Valuable POST	Don't Use POST	Sig Pre/Post Change %
 Educational management software (attendance, grades, lesson plans, etc.)	93%	64%	29%	3%	NSD
 Word processing	84%	48%	36%	6%	NSD
 Internet for research	83%	52%	31%	6%	NSD
 Email	81%	52%	29%	7%	NSD
 Presentation software (Keynote, PowerPoint)	73%	37%	36%	14%	4% more users, 7% more say very valuable, and 3% more say valuable (p = .0135)
 Multimedia reference tools (CD-ROMS, online encyclopedia)	59%	19%	40%	22%	NSD
 Other web based learning activities	51%	13%	38%	26%	7% more users, 6% more say valuable or very valuable (p = .0413)
 Data management (spreadsheets), graphing, or analysis software (EXCEL, SPSS, STATVIEW, etc.)	46%	11%	35%	31%	NSD
 Web based digital curriculum or curriculum resources	42%	11%	31%	35%	8% more users, ratings of value are split (p = .0435)
 Drill & practice software, integrated learning systems and/or educational games	40%	6%	34%	33%	9% more users, 7% more say little or no value (p < .001)
 Video, graphics, or sound editing/production software (itunes, imovie, garage band, iDVD, movie maker)	34%	11%	23%	47%	10% more users, 8% more say valuable or very valuable (p = .002)
 Desktop publishing software (PageMaker, Pages, Publisher, etc.)	32%	8%	24%	45%	5% more users, ratings of value are split
 Simulations/modeling software	31%	7%	24%	49%	7% more users, 5% more say valuable (p = .01998)
 Other communication tools (IM, ichat, discussion boards, video conferencing)	28%	8%	20%	49%	10% more users, 6% more say valuable or very valuable (p = .001)
 Web publishing software (Dreamweaver, iWeb, etc.)	19%	4%	15%	58%	9% more users, 7% more say little or no value (p < .001)
 Probeware (input devices for gathering data)	20%	4%	16%	62%	8% more users, ratings of value are split (p < .001)
 Database software (FileMaker, Access)	18%	3%	15%	54%	8% more users, 7% more say little or no value (p = .0135)

Table 2-2
Summary of Pre/Post Differences in Year Two
Teacher Technology Use and Perceived Value of Software Applications


















Year Two CFF Teacher Ratings of the Value of Software Applications	Valuable and Very Valuable POST	Very Valuable POST	Valuable POST	Don't Use POST	Sig Pre/Post Change %
 Educational management software (attendance, grades, lesson plans, etc.)	96%	67%	29%	1%	4% more say very valuable (p < .001)
 Internet for research	88%	58%	30%	3%	4% more users, 6% more say very valuable (p < .001)
 Word processing	87%	48%	39%	4%	4% more users, 5% more say valuable or very valuable (p < .001)
 Email	87%	60%	27%	4%	2% more users, 5% more say very valuable (p < .001)
 Presentation software (Keynote, PowerPoint)	81%	42%	39%	7%	10% more users, 12% more say valuable or very valuable (p < .001)
 Other web based learning activities	57%	17%	40%	18%	11% more users, 8% more say valuable or very valuable (p < .001)
 Multimedia reference tools (CD-ROMS, online encyclopedia)	55%	19%	36%	22%	5% more users, ratings of value are split (p < .001)
 Data management (spreadsheets), graphing, or analysis software (EXCEL, SPSS, STATVIEW, etc.)	51%	15%	36%	23%	8% more users, ratings of value are split (p < .001)
 Drill & practice software, integrated learning systems and/or educational games	47%	9%	38%	28%	11% more users, 7% more say valuable or very valuable (p < .001)
 Web based digital curriculum or curriculum resources	46%	13%	33%	29%	10% more users, 7% more say valuable or very valuable (p < .001)
 Video, graphics, or sound editing/production software (itunes, imovie, garage band, iDVD, movie maker)	40%	14%	26%	38%	17% more users, 12% more say valuable or very valuable (p < .001)
 Simulations / modeling software	38%	12%	26%	40%	10% more users, ratings of value are split (p < .001)
 Desktop publishing software (PageMaker, Pages, Publisher, etc.)	33%	9%	24%	42%	12% more users, ratings of value are split (p < .001)
 Other communication tools (IM, ichat, discussion boards, video conferencing)	33%	9%	24%	40%	18% more users, 12% more say valuable or very valuable (p < .001)
 Probeware (input devices for gathering data)	21%	8%	13%	58%	7% more users, 6% more say little or no value (p = < . .001)
 Web publishing software (Dreamweaver, iWeb, etc.)	19%	5%	14%	57%	10% more users, 7% more say little or no value (p < .001)
 Database software (FileMaker, Access)	19%	4%	15%	52%	8% more users, 6% more say little or no value (p < .001)

Table 2-3
Summary of Year One Post vs. Year Two Post Differences in
Teacher Technology Use and the Perceived Value of Software Applications

Year One vs Year Two Comparisons of CFF Teacher Ratings of the Value of Software Applications	Perceived Value Rank		% of CFF Teachers Using		% Reporting as Valuable or Very Valuable		Statistical Significance
	Year 2	Year 1	Year 2	Year 1	Year 2	Year 1	Y2 vs Y1
💡 Educational management software (attendance, grades, lesson plans, etc.)	1	1	99%	97%	96%	93%	p = .002
💡 Internet for research	2	3	97%	94%	88%	83%	p < .001
💡 Word processing	3	2	96%	94%	87%	84%	NSD
💡 Email	4	4	96%	93%	87%	81%	p < .001
💡 Presentation software (Keynote, PowerPoint)	5	5	93%	86%	81%	73%	p < .001
💡 Other web based learning activities	6	7	82%	74%	57%	51%	p < .001
💡 Multimedia reference tools (CD-ROMS, online encyclopedia)	7	6	78%	78%	55%	59%	NSD
💡 Data management (spreadsheets), graphing, or analysis software (EXCEL, SPSS, STATVIEW, etc.)	8	8	77%	69%	51%	46%	p < .001
💡 Drill & practice software, integrated learning systems, and/or educational games	9	10	72%	67%	47%	40%	p = .011
💡 Web based digital curriculum or curriculum resources	10	9	71%	65%	46%	42%	p = .032
💡 Video, graphics, or sound editing/production software (itunes, imovie, garage band, iDVD, movie maker)	11	11	62%	53%	40%	34%	p < .001
💡 Simulations / modeling software	12	13	60%	51%	38%	31%	p < .001
💡 Desktop publishing software (PageMaker, Pages, Publisher, etc.)	13	12	58%	55%	33%	32%	NSD
💡 Other communication tools (IM, ichat, discussion boards, video conferencing)	14	14	60%	51%	33%	28%	p < .001
💡 Probeware (input devices for gathering data)	15	16	42%	38%	21%	20%	p < .001
💡 Web publishing software (Dreamweaver, iWeb, etc.)	16	15	43%	42%	19%	19%	NSD
💡 Database software (FileMaker, Access)	17	17	48%	46%	19%	18%	NSD

What Instructional Strategies are Used in CFF Classrooms?

CFF Survey Year One

Teacher Survey (Q 9a-l):

Teacher pre/post survey response comparisons showed significant decreases in the perceived value of lecture or demonstration and teacher-led discussion aimed at high-level outcomes, which experienced shifts from very valuable to valuable of approximately 7% ($\chi^2 = 10.04$, $p=.0397$) and 6% ($\chi^2 = 9.92$, $p=.0418$) respectively. Significant differences were noted in the use and perceived value of "webquests" ($\chi^2 = 12.11$, $p=.0165$), with 9% more teachers reporting using them and mixed reports on webquests' value in their classes. A significant shift ($\chi^2 = 14.68$, $p = .0054$) also occurred in the area of "learning centers" with 9% more teachers reporting using them and most finding them valuable.

Observations Year One (Q23)

From the pre to the post observation period there were significant reductions in the use of teacher lecture or demonstration and in low level, factual, teacher-led discussions.

CFF Survey Year Two

Teacher Survey (Q 9a-l):

Teacher pre/post survey response comparisons again showed significant decreases in the perceived value of lecture or demonstration and teacher-led discussion aimed at high level outcomes, which experienced shifts from very valuable to valuable of approximately 7% ($\chi^2 = 8.097$, $p < .001$) and 6% ($\chi^2 = 53.03$, $p < .001$) respectively. There was also a significant decrease in the perceived value of teacher-led discussion aimed at factual, knowledge-level content ($\chi^2 = 65.20$, $p < .001$), which experienced a shift of approximately 6% from very valuable to valuable.

While teacher perceptions of the value of lecture, demonstration and discussion declined, teacher perceptions of the value of project-based learning, authentic learning, multi-modal teaching, peer teaching or peer tutoring, collaborative learning, learning centers, and webquests all increased significantly ($p < .001$).

Observations Year Two (Q23)

Statistically significant differences indicating:

- Less lecture-based learning ($p < .001$)

CFF Survey Y1 and Y2 Compared

Teacher Survey (Q 9a-l):

Comparison of the responses from Years One and Two indicate that as teachers implement CFF there are significant trends in the use and perceived value of different instructional strategies.

As teachers implement CFF the perceived value of traditional approaches (lecture, demonstration, and discussion) tends to be reduced in value, with about 6% of respondents changing their perceptions of these methods from very valuable to valuable.

During this transition, some teachers begin to use alternative strategies, with the largest changes evident in the increased use of webquests (12% increase), learning centers (8% increase), and collaborative learning (5% increase).

Observation Y1 and Y2 Compared

Across both Years One and Two, there was a reduction in lecture-based strategies and an increase in student-centered instructional strategies. In Year

Observations Year One (Q23)

From the pre to the post observation period there were significant reductions in the use of teacher lecture or demonstration and in low level, factual, teacher-led discussions. There were significant increases in the use of project- or problem-based learning, authentic learning, multi-modal teaching, peer teaching, and in both informal collaborative learning and collaborative learning with formal assigned roles to participants.

Observations Year Two (Q23)

Statistically significant differences indicating:

- Less lecture-based learning ($p < .001$)
- More project or problem-based learning ($p = .001$)
- More authentic learning ($p = .007$)
- More multi-modal teaching ($p = .003$)
- More peer teaching ($p < .001$)
- More informal collaborative learning ($p < .001$)
- More collaborative learning with formal roles ($p = .029$)
- More use of webquests ($p = .001$)
- More use of learning centers ($p = .038$)

Observation Y1 and Y2 Compared

Across both Years One and Two, there was a reduction in lecture-based strategies and an increase in student-centered instructional strategies. In Year Two the statistically significant differences included increases in the use of webquests and learning centers (not found in Year One) and did not reveal statistically significant differences in teacher-led discussions.

CFF Interview Results

The principals and the project managers reported seeing more student-centered classrooms with the teacher taking a support role. A project manager talked about the changes saying, "Teachers are delivering content in a different way. They are getting more creative in how to deliver the content. And they are also getting much more creative in how they are assessing the students. Prior to this, all the students had the same assignment, had to do the same set of skills, but we have been able to differentiate instruction to a much greater level. And students have been able to do much more in-depth projects, so the teachers have really been able to change not only how they deliver the instruction but also the degree to which the students perform skills and also how they assess those skills."

Our interviews also indicate that students are more likely to be in groups working with laptops and making presentations than sitting quietly at their desks. One principal stated that, "Students are much more engaged. For example, in physics, students were able to view experiments in different formats." They also noted more differentiated instruction and visual learning being incorporated. In one case, a social studies teacher working with students learning about the 13 colonies had students using maps from the Internet instead of lecturing. One principal reported:

Y2 Conclusions

The answer to the question, "What instructional strategies are in use in CFF classrooms?" is that lecture-based approaches seem to be giving way to more learner-centered approaches. Trained observers in CFF classrooms reported that CFF teachers exhibited increased use of all learner-centered practices, including project or problem-based learning, authentic learning, multi-modal teaching, peer teaching, both formal and informal collaborative learning ($p < .001$) more collaborative learning, and the use of learning centers.

Do the Instructional Strategies Used by CFF Teachers Appear to Change in Ways Supported by the TPR's Five Research –based Domains?

TPR Observations Year One

Statistically significant differences were found for the domains of "Focus/Capacity" ($t= 3.286$, $p=.001$) and for "Provisions for Evaluation" ($t= 2.505$, $p=.013$). The differences exhibited for two other domains, "Social System" ($t= 1.832$, $p=.068$) and "Principles of Reaction" ($t= 1.960$, $p=.051$), approached but did not attain the level set to identify statistically significant differences (.05).

TPR Observations Year Two

Statistically significant differences were found for all five domains:

- "Focus/Capacity" ($t= 6.879$, $p < .001$)
- "Syntax" ($t= 4.247$, $p < .001$)
- "Principles of Reaction" ($t= 5.399$, $p < .001$)
- "Social System" ($t= 6.345$, $p < .001$)
- "Provisions for Evaluation" ($t= 7.520$, $p < .001$).

TPR Observation Y1 and Y2 Compared

More statistically significant differences were found in Year Two than in Year One.

This could be due to the increased length of time many teachers had to work with the technologies and to change teaching methods, due to more experienced coaches working with the teachers, due to some combination of these factors, or due to other factors.

Y2 Conclusions

The answer to this question is "Yes." The instructional strategies used by CFF teachers do appear to change in ways that are supported by the five research-based domains that have been identified as being associated with gains in achievement by the "Teaching Performance Record" (TPR). Statistically significant, favorable gains were exhibited in all five domains, indicating an increased quality of teaching.

About the "TPR"

Developed by faculty and students at the University of Virginia, the "**Teaching Performance Record**" (TPR) observation tool offers a valid, reliable method to collect information on the teaching practices of teachers and to analyze them based on factors shown to be associated with increased student achievement. The TPR describes the extent to which teachers behave in ways that influence student academic learning, involvement in classes, and motivation. After using the observation tool, administrators are presented with informative reports on the classroom practices of their teachers, as well as suggestions for post-observation conferencing, and targeted professional development plans for individual teachers and their entire faculty. For the purposes of this study, we seek to determine whether teachers engaging in the CFF program are progressing in terms of the five categories of teacher behaviors associated with enhancing student achievement: Focus/Capacity, Syntax, Principles of Reaction, Social System, and Provisions for Evaluation. Each of these categories of teacher activity is described below, in the words of CaseNEX, the developers of the instrument.

Focus/Capacity (17 items): Teachers demonstrate this attribute of Strategic Teaching when they concentrate on purpose—that is, subject matter, goals, and objectives of the lesson. They do so by addressing standards of learning, pre-assessments of students' prior learning, interests, and abilities, including their cultural and learning needs. Teachers provide the time and intellectual coherence it takes for individuals and groups to develop deep understanding of material, being careful to draw attention to big ideas as they progress. This concept also includes attention to the support system or capacity to create the conditions necessary for teaching the particular content—support such as special teaching skills and technology.

Syntax (17 Items): Teachers attend to Syntax, or the sequence of classroom events, when they plan and implement various teaching activities. This attribute of Strategic Teaching reveals itself through activities that communicate there are beginnings, middles, and ends of lessons. Teachers begin on time and transition smoothly between lesson phases. They stimulate curiosity, review previously learned material, introduce new content, integrate the new with the old, drill down on unfamiliar ideas, summarize progress, give directions for homework, provide options for learning, and the like. Because the lesson has an underlying structure of events, students can perceive a logical flow of work: "This is where we are going, this is how we will get there, this is how we will know we have arrived."

Principles of Reaction (27 items): Principles of Reaction can be thought of as the many tactics of teaching. Teachers use rules of thumb, often from moment to moment, to gauge student intellectual engagement, motivation, and frustration. These guidelines help teachers, in turn, fashion responses to what students do. Teachers ask different kinds of questions and handle responses in myriad ways. They prompt, help, wait, restate, elicit, answer, probe, redirect, connect, reward, challenge, encourage, praise, and in other ways behave to promote desirable student performance.

Social System (25 Items): Teachers build and maintain social systems conducive to student learning by attending to roles and relationships within classrooms and by sanctioning student behavior. Teachers are friendly, supportive, helpful, and encouraging. They express expectations

for behavior, build rapport, acknowledge students' feelings, communicate consequences, and praise and punish when appropriate. Their classroom routines provide opportunities to involve students in both academic and non-academic activities. In general, "social system" can be characterized in terms of teachers' efforts to create and sustain a positive social climate.

Provisions for Evaluation (25 Items): Evaluation serves both formative and summative purposes—that is for purposes of improving learning and making summary judgments about progress. Teachers demonstrate concern for evaluating students, and simultaneously judge their own teaching in a variety of ways through their planning and interaction with students. Teachers judge student performance in relation to standards of learning, to instructional goals and objectives and to students' needs and abilities. They set benchmarks or expectations for progress—and communicate these to students. They monitor students for involvement, interest, and participation. Teachers evaluate when they verify student understanding and provide constructive criticism. Teachers may be assessing educational progress as they monitor students' work, as they check completion of work, and as they hold students accountable for their progress. Teachers who encourage students, both collectively and individually, to reflect on what they have learned are creating opportunities to evaluate progress. "Evaluation" connotes "attaching value" to students' products and performances; to do so, teachers maintain records of progress. Teachers often evaluate learning (and their own teaching) using various types of instrumentation and different philosophical approaches.

Is There a Difference in the Attention Paid to “21st Century Skills” in CFF Classrooms?

CFF Survey Year One

Teacher Survey (Q6):

Despite a 5% decrease in the number of teachers reporting devoting only 1% to 25% of class time to the development of 21st Century Skills and corresponding gains in categories reflecting more time spent, the pre/post difference approached, but did not reach statistical significance ($\chi^2 = 8.42$, $p < .077$).

	PRE	POST
None	1%	1%
1% to 25%	33%	28%
25% to 50%	36%	38%
50% to 75%	21%	23%
> 75%	9%	10%

Student Survey (Q1):

In an item that asked how well their schools are preparing them for the modern workplace, significant pre/post differences ($\chi^2 = 33.43$, $p < .001$) indicate that student perceptions improved, despite the relatively high levels of support for this position during the pre assessment. In the post assessment, 25% strongly agreed (up from 21%), and 49% agreed (down from 52%) that their schools are preparing them for the modern workplace.

CFF Survey Year Two

Teacher Survey (Q6):

There was a significant pre/post difference ($\chi^2 = 77.47$, $p < .001$) in Year Two, with teachers reporting spending more time engaged in the teaching of 21st Century Skills following CFF implementation.

	PRE	POST
None	1%	0%
1% to 25%	31%	25%
25% to 50%	38%	43%
50% to 75%	23%	25%
> 75%	7%	6%

Student Survey (Q1):

Highly significant pre/post differences ($\chi^2 = 294.68$, $p < .001$) indicate that student perceptions improved again in Year Two, again despite the relatively high levels of support during the pre assessment. In the post assessment, 24% strongly agreed (up from 21%), and, again, 49% agreed (down from 52%) that their schools are preparing them for the modern workplace.

CFF Survey Y1 and Y2 Compared

Teacher Survey (Q6):

The patterns exhibited in Year One and Year Two were statistically significantly different ($\chi^2 = 40.04$, $p < .001$). The difference was driven by changes in the 25% to 50% and > 75% categories. Teachers in Year One recorded a 2.1% gain in the 25% to 50% category as compared to Year Two's 4.9% gain. In the > 75% category, there was a 1.3% gain in Year One and a .8% decrease in Year Two.

Student Survey (Q1):

Consistently, across Years One and Two, students gave their schools high marks during the pre assessment (with approximately 74% agreeing or strongly agreeing) that their schools are preparing them for the modern workplace. Also consistently, the pre/post shift indicates movement from "Agree" to "Strongly Agree."

Observations Year One (Q27)

CFF observers looked specifically for the presence of 12 different "21st century skills," including: Visual Literacy, Scientific Literacy, Cultural Literacy or Global Awareness, Teaming or Collaboration Skills, Social or Personal Responsibility, Self-Direction, Creativity, Higher-Order Thinking, Use of Real World Tools, Ability to Produce High Quality Products, and Planning, Prioritizing, and Managing Work. Observers rated the presence of each category as "Not at All," "Somewhat," or "Substantially" visible in the lesson, or "Not Applicable" if there was a reason not to use one of the other options. "Not Applicable" responses were omitted from the analyses.

The results of this analysis showed significant differences ($p < .05$) from pre to post observations in all categories of 21st century skills except "Self Direction" ($p = .557$) and Visual Literacy ($p = .058$), which approached but did not exceed the level set to define significant differences (.05).

Observations Year Two (Q27)

The results of the Year Two analysis showed significant differences ($p < .05$) from pre to post observations, the extent to which the class session "*made an effort to specifically provide instruction in or employ strategies to develop:*"

- Visual Literacy ($p = .037$)
- Teaming or Collaboration Skill ($p < .001$)
- E-Communication Skills ($p < .001$)
- Social or Personal Responsibility ($p < .001$)
- Self-Direction ($p = .012$)
- Creativity ($p < .001$)
- Use of Real World Tools ($p < .001$)
- Ability to Produce High Quality Products ($p < .001$)
- Planning, Prioritizing, and Managing Work ($p = .025$)

Pre/post observation gains were not statistically significant in:

- Scientific Literacy ($p = .171$)
- Cultural Literacy or Global Awareness ($p = .100$), or
- Higher-Order Thinking ($p < .113$)

Observation Y1 and Y2 Compared

In Year One, significant increases in attention to ten of the twelve 21st century skills were noted by observers, and in Year Two significant change was noted in nine of the twelve. Significant gains were noted for all twelve skills in at least one of the two years. Significant gains were evident in seven of these skills in both years:

- Teaming or Collaboration Skill
- E-Communication Skills
- Social or Personal Responsibility
- Creativity
- Use of Real World Tools
- Ability to Produce High Quality Products, and
- Planning, Prioritizing, and Managing Work

CFF Interview Results

While principals did not identify 21st century skills as the main focus of the CFF program, it was a thread extending through many of their interview responses. The primary focus for the principals was the change in teaching style to a more student-centered environment, which in turn, helps students prepare for the 21st century. In answering a question about the nature of the CFF program, 12% of the principals' responses identified 21st century teaching and learning, and in naming a single focus of the program, 12% of the responses reported that CFF encourages the development of 21st century learning skills.

The project managers also spoke about 21st century skills, reporting, "The teachers are just so enthusiastic and excited about what they're doing. Even some teachers that have been here for some 25 years are understanding philosophically what the purpose of the program is. They're talking about the way they're changing their teaching, the way they are thinking about 21st century learners. They did it, and they're excited about it. That is amazing to see with teachers, who had become a little too used to teaching the traditional way."

Y2 Conclusions

The answer to the question, "Is There a Difference in the Attention Paid to '21st Century Skills' in CFF Classrooms?" is "Yes." Significant additional attention was paid to seven of the identified skills in both years, and all twelve were the focus of significant gains in attention in at least one year. The CFF program appears to be resulting in an increased focus on 21st century skills.

Section 3: Impact on Student Activity

In this section, assessing CFF's impact on student activities, six questions will guide the discussion:

- Has CFF changed the level of student engagement?
- What is the most valuable aspect of the CFF program for students?
- What observations do key informants report about the impact that CFF has on student achievement?
- Has CFF changed percentages of time students are listening, engaged in independent work, or working in groups or teams?
- In CFF classrooms, how much time do students spend using computers?
- Does CFF change the type of products on which students' grades are based?

Has CFF Changed the Level of Student Engagement?

CFF Survey Year One

Teacher Survey (Q7):

Pre/post difference was not statistically significant.

Student Survey (Q5):

Small, but statistically significant differences show that student interest has decreased very slightly during the pre/post window.

CFF Survey Year Two

Teacher Survey (Q7):

Statistically significant difference in the percentage of students who are reported as being actively engaged ($p = .0372$), but with very small percentage changes (less than 2% changing categories).

Student Survey (Q5):

Very small, but statistically significant differences show that student interest has decreased during the pre/post window.

CFF Survey Y1 and Y2 Compared

Teacher Survey (Q7):

Very limited support indicating shifts in student engagement.

Student Survey (Q5):

Very small decreases in student engagement and interest are exhibited in pre/post student surveys, but some of that may be due to an end-of-year student malaise that is often reported among high school students.

Observations Year One

CFF Observation (Q4, 9, 14):

While the *percentage* of students engaged during the pre and post observations did not change significantly in Year One, there were statistically significant and noteworthy increases in the *level* of engagement for all three thirds of the class session ($t = -3.62, -2.03, -2.61$; $p < .05$).

Observations Year Two

CFF Observation (Q4, 9, 14):

The 5.3% pre/post difference in the percentage of engaged students was not significantly different during the first third of the class ($p = .154$), but the 6.4% difference in the second third of the class approached significance ($p = .086$) and the 13.4% difference for the final third was statistically significant ($p = .001$).

As was the case in the Year One observations, the pre/post difference in the level of engagement observed was statistically significant in all three thirds of the class session, rising .5 in the first third, to 3.6, .4 in the second third, to 3.8, and .6 in the final third, to 3.8, on the item's five-point scale. All of these differences were statistically significant ($p < .001$).

Observation Y1 and Y2 Compared

In Year Two we saw the first significant change in the percentage of students who were engaged, with a 13.4% reported increase in engagement.

Significant changes in the level of engagement were present in all three thirds of the class, in both Years One and Two.

CFF Interview Results

The CFF interview process revealed that many of those interviewed believe that the program has definitely had an impact on the level of student engagement. In responding to a question on the problems or issue they expected the program to solve, there was a consensus by principals, project managers and technology directors that student engagement was a key issue they hoped the program would address in motivating students to take ownership of their learning. When asked whether there were changes in student engagement, nearly all the principals and project managers interviewed responded, "Yes." They are seeing fewer worksheets and more movement in the classroom. As one principal noted the change in engagement, "Some classrooms seemed like instruction was somewhat flat, kids were working on worksheets, not much interaction, now the same kids are out of their seats and going to whiteboards. I think it has added a dimension of movement and more engaging kinds of lessons, not just seat work."

Y2 Conclusions

The evidence related to the question, "Has CFF Changed the Level of Student Engagement?" includes conflicting perspectives. Most evidence from the teacher surveys reports little change in student engagement, with the only significant change being small shifts in the reported percentage of students who are engaged in Year Two. Student survey data indicates that if there are changes in engagement, they are small and negative, but student attitudes toward school are often lower toward the end of the school year than at the beginning. However, in our interviews principals and coaches testified that students *are* more engaged, and this perspective is reinforced by the reports of trained observers, who noted one significant change in the percentage of students engaged (Year Two, final third of the class), and consistent changes in the level or intensity of engagement in both Years One and Two and in all three thirds of the class session. Our conclusion at this time is that the answer to this question is still unclear.

Has CFF Changed Percentages of Time Students are Listening, Engaged in Independent Work, and Working in Groups or Teams?

CFF Survey Year One

Teacher Survey (Q10):

In Year One pre/post surveys, teachers reported that students spent more time:

- Listening to other students (in a large group setting) ($p = .028$)
- Working in groups ($p = .011$), and
- Using Computers ($p < .001$)

The increased time teachers reported that students spend working independently approached the level of statistical significance, but did not reach it ($p = .0841$).

Student Survey (Q6):

In Year One pre/post surveys, the pre and post responses to the seven items about how students spent their time were similar, with no changes in a single category exceeding 5%. Because of the large number of students, all shifts are considered statistically significant, and four of these patterns of differences were sufficiently directional to indicate a possible trend. Students reported spending more time:

CFF Survey Year Two

Teacher Survey (Q10):

In Year Two pre/post surveys, teachers reported that students spent significantly:

- Less time listening to the teacher (in a large group setting) ($p < .001$)
- More time listening to other students (in a large group setting) ($p < .001$)
- More time working in groups ($p < .001$),
- More time talking with the teacher in 1-to-1 or small group conversations ($p < .001$),
- Less time off task ($p = .02$) and
- More time using Computers ($p < .001$)

When assessing the amount of time students spend working independently on the Year Two survey, teachers reported significantly different patterns of responses in the pre and post periods, but rather than indicating an increase or decrease, the responses appear to indicate a small shift toward the middle categories, with a 2% increase in the 21% to 49% category and a 1% increase in the 41% to 60% category, with small decreases at the high and low ends of the scale. ($p < .001$).

CFF Survey Y1 and Y2 Compared

The evidence from the Years One and Two survey questions described in this section, when viewed in conjunction with the survey questions and observation data reported above on how teachers spend their time, indicates that teachers spend less time engaged in lecture and students spend less time listening to the teacher. Teachers spend more time working with individuals and with small groups, and students spend more time working in groups, and talking and listening to other students, and using computers. The evidence that students spend more time working independently approached, but did not attain the level required for statistical significance on the teacher surveys in Year One, but in Year Two we saw a statistically significant difference indicating that more students are spending 21% to 40% of their time working independently.

<ul style="list-style-type: none"> • Working by themselves ($\text{Chi}^2 = 30.78, p < .001$) • Talking with the teacher one-to-one ($\text{Chi}^2 = 79.56, p < .001$) • Working with the teacher in a small group ($\text{Chi}^2 = 124.36, p < .001$), and • Not really paying attention ($\text{Chi}^2 = 52.06, p < .001$) <p>The patterns of change appeared more random for the items related to the amount of time spent listening to the teacher in a large group setting and listening to other students as a whole class.</p>	<p>Student Survey (Q6):</p> <p>In Year Two pre/post surveys, the pre and post responses to the seven items about how students spent their time were strikingly similar, with an average of only 2.7% shifts from category. Because of the large number of students, all shifts were considered statistically significant, but only one, the time students reported spending off task, changed in a noteworthy way.</p> <p>In terms of time on task, students reported a shift toward spending more time off task, with 5% of students shifting categories toward more time spend off task.</p> <p>All other items reflected shifts from category to category of 2% or less.</p>	
<p><u>Observations Year One</u></p> <p>The Year One pre/post analysis of how CFF observers reported students spent their time show three statistically significant differences:</p> <ul style="list-style-type: none"> • Students spent less time listening to the teacher ($p < .001$) • Students spent more time listening to other students in large groups ($p = .002$), and • Students spent significantly less 	<p><u>Observations Year Two</u></p> <p>The Year Two pre/post analysis of how CFF Observers reported students spent their time show two statistically significant differences:</p> <ul style="list-style-type: none"> • Students spent 12% less time listening to the teacher ($p < .001$), and • Students spent 6% more time working in groups ($p = .046$). 	<p><u>Observation Y1 and Y2 Compared</u></p> <p>The pre/post changes indicated by the CFF observations in Years One and Two both point to a reduction in the amount of time students spend listening to the teacher in large group settings. The other significant differences showing increases in the time students spend working in groups and listening to other students appeared in either Year One or Year Two, but not both.</p>

Observations Year One

The Year One pre/post analysis of how CFF observers reported students spent their time show three statistically significant differences:

- Students spent less time listening to the teacher ($p < .001$)
- Students spent more time listening to other students in large groups ($p = .002$), and
- Students spent significantly less time "off task" (doing things other than what the teacher had intended), with the percentage of time off task dropping from 5% to 3% ($p < .018$).

Observations Year Two

The Year Two pre/post analysis of how CFF Observers reported students spent their time show two statistically significant differences:

- Students spent 12% less time listening to the teacher ($p < .001$), and
- Students spent 6% more time working in groups ($p = .046$).

Other small increases were not statistically significant, although the 5% increase in time students worked independently approached significance ($p = .096$).

The insignificant change in the percentage of time it was reported that students were off task reflected a decrease from 2.8% to 2.3% of time off-task.

Observation Y1 and Y2 Compared

The pre/post changes indicated by the CFF observations in Years One and Two both point to a reduction in the amount of time students spend listening to the teacher in large group settings. The other significant differences showing increases in the time students spend working in groups and listening to other students appeared in either Year One or Year Two, but not both.

A significant decrease in the time students spent off task appeared in year one, but not in Year Two. This could be due to the fact that the time spent off task was very low in both the pre and post observations (2.8% pre and 2.3% post).

CFF Interview Results

The level of student engagement has been influenced by changes in the classroom environment. In responding to a question on changes in classroom practice, principals saw more active learning, interaction, and collaboration among students (37%). They also

In CFF Classrooms How Much Time Do Students Spend Using Computers?

CFF Survey Year One

Teacher Survey (Q10g):

In Year One, CFF teachers report that their students spend significantly more time using computers on the post surveys than they did on the pre surveys ($\text{Chi}^2 = 34.41$, $p < .001$), with a 15% decrease (from 63% to 48%) in the percentage of CFF teachers reporting that their students use computers from 0% to 20% of the time. When combined with the 27% of teachers who reported that their students spend between 21% and 40% of their time using computers, we see that three-fourths (75%) of the CFF students, according to their teachers, use the computers 40% of the time or less.

Student Survey (Q6h):

In Year One, students report spending significantly more time using computers on the post surveys than they did on the pre surveys ($\text{Chi}^2 = 187.70$, $p < .001$), with increases in all three of the top computer use categories and decreases in the two lowest levels. Students report that 43% spend more than 60% of their time using computers. Twenty-three percent of students spend between 61% and 80% of class time using computers and 21% of students reported spending between 61% and 80%.

CFF Survey Year Two

Teacher Survey (Q10g):

As in Year One, in Year Two, CFF teachers report that their students spend significantly more time using computers on the post surveys than they did on the pre surveys ($\text{Chi}^2 = 911.91$, $p < .001$), with a 27% decrease (from 66% to 39%) in the percentage of CFF teachers reporting that their students use computers from 0% to 20% of the time. When combined with the 33% of teachers who reported that their students spend between 21% and 40% of their time using computers, we see that 72% of the CFF students, according to their teachers, use the computers 40% of the time or less.

Student Survey (Q6h):

As in Year One, students report spending significantly more time using computers on the Y2 post surveys than they did on the pre surveys ($\text{Chi}^2 = 6709.15$, $p < .001$), with increases in all three of the top computer use categories and decreases in the two lowest levels. Students report that 42% spend more than 60% of their time using computers. Twenty-three percent of students spend between 61% and 80% of class time using computers and 19% of students reported spending between 61% and 80%.

CFF Survey Y1 and Y2 Compared

Teacher Survey (Q10g):

The teacher surveys for the two years are quite similar at the post survey point, after slightly larger changes in the top categories in Year Two.

Student Survey (Q6h):

As was the case with the teacher surveys, the student surveys for the two years are remarkably similar at the post survey point, after slightly larger changes in the top categories in Year Two.

However, although the trends indicating greater technology use were similar, the levels of technology use that teachers and students report are not. Students report that about 42% of students use technology 60% or more, while teachers reported only 10% in Y1 and 12% in Y2 at that level of technology use. Another teacher assessment of technology use, the PATI survey, verifies the teachers' lower assessment of technology use, as only one-third of CFF teachers say that their students use technology more than two hours per week, which would be about 40 to 50 % of the time.

CFF Survey Year One

Teacher Survey (Q10g):

In Year One, CFF teachers report that their students spend significantly more time using computers on the post surveys than they did on the pre surveys ($\text{Chi}^2 = 34.41$, $p < .001$), with a 15% decrease (from 63% to 48%) in the percentage of CFF teachers reporting that their students use computers from 0% to 20% of the time. When combined with the 27% of teachers who reported that their students spend between 21% and 40% of their time using computers, we see that three-fourths (75%) of the CFF students, according to their teachers, use the computers 40% of the time or less.

Student Survey (Q6h):

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CFF Survey Year Two

Teacher Survey (Q10g):

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CFF Survey Y1 and Y2 Compared

Teacher Survey (Q10g):

The teacher surveys for the two years are quite similar at the post survey point, after slightly larger changes in the top categories in Year Two.

Student Survey (Q6h):

As was the case with the teacher surveys, the student surveys for the two years are remarkably similar at the post survey point, after slightly larger changes in the top categories in Year Two.

However, although the trends indicating greater technology use were similar, the levels of technology use that teachers and students report are not. Students report that about 42% of students use technology 60% or more, while teachers reported only 10% in Y1 and 12% in Y2 at that level of technology use. Another teacher assessment of technology use, the PATI survey, verifies the teachers' lower assessment of technology use, as only one-third of CFF teachers say that their students use technology more than two hours per week, which would be about 40 to 50 % of

Y2 Conclusions

In CFF classrooms how much time do students spend using computers? About 42% of students report using technology 60% or more, while teachers report that only about 10% of their classes spend that much time using technology. The CFF observers report that they see about 40% of students using the technology almost the entire period, but it is quite possible that teachers increase technology use when observers are present. Although it is difficult to estimate use based on these three different perspectives, it may be fair to say that the level of use may not have reached the level anticipated by CFF leaders. These numbers may increase as teachers get more comfortable with the technologies and with their new roles, but additional attention to this important variable may also be warranted.

Does CFF Change the Type of Products on Which Students' Grades are Based?

CFF Survey Year One

Teacher Survey (Q11a-g):

Changes in teacher response patterns between the pre and post surveys indicate significant increases in the percentage of the grade teachers attribute to:

- Oral Reports and Presentations ($\text{Chi}^2 = 23.08, p < .001$)
- Projects ($\text{Chi}^2 = 24.12, p < .001$)
- Class Participation ($\text{Chi}^2 = 25.47, p < .001$)
- Work Produced by a Group or Team ($\text{Chi}^2 = 39.26, p < .001$)

The pre/post changes were not significant for:

- Tests and Quizzes ($\text{Chi}^2 = 2.34, p = .674$)
- Papers and Written Reports ($\text{Chi}^2 = 3.32, p = .505$)
- Working Independently ($\text{Chi}^2 = 23.08, p < .001$)

Student Survey (Q7):

Changes in student response patterns between the pre and post surveys indicate significant increases in the percentage of the grade students report teachers attribute

CFF Survey Year Two

Teacher Survey (Q11a-g):

Changes in teacher response patterns between the pre and post surveys indicate significant increases in the percentage of the grade teachers attribute to:

- Oral Reports and Presentations ($\text{Chi}^2 = 82.63, p < .001$)
- Projects ($\text{Chi}^2 = 62.68, p < .001$)
- Work Produced by a Group or Team ($\text{Chi}^2 = 73.15, p < .001$)

Significant *decreases* were noted in the percentage of the grade teachers attribute to:

- Tests and Quizzes ($\text{Chi}^2 = 48.54, p < .001$)
- Working independently ($\text{Chi}^2 = 19.86, p < .001$)

The pre/post changes were significant but the changes in categories were all less than 1% and direction was not apparent for:

- Papers and Written Reports ($\text{Chi}^2 = 14.61, p = .00558$)
- Class Participation ($\text{Chi}^2 = 10.83, p = .0285$)

CFF Survey Y1 and Y2 Compared

Teacher survey responses across Years One and Two indicate consistent increases between the pre and post surveys in the use of oral reports and presentations, projects, and group work in grading. The Year Two survey shows significant decreases in the importance placed on tests and quizzes and independent work.

Changes in pre/post student survey responses across the two years consistently indicate that teachers are placing an increased emphasis on group projects, oral reports and presentations, and independent projects during assessment.

to:

- Work that is shared in a meaningful way with an audience outside the classroom ($\chi^2 = 160.12$, $p < .001$)
- Oral Reports and Presentations ($\chi^2 = 107.45$, $p < .001$)
- Class Participation ($\chi^2 = 79.25$, $p < .001$)
- Group Projects ($\chi^2 = 85.09$, $p < .001$), and
- Independent Projects ($\chi^2 = 69.11$, $p < .001$).

The pre/post changes were statistically significant, but the direction was not apparent for:

- Work that is simply handed in and graded by the teachers ($\chi^2 = 19.24$, $p < .001$), and
- Papers and Written Reports ($\chi^2 = 14.82$, $p = .005082$).

The pre/post changes were not statistically significant for tests and quizzes ($\chi^2 = 6.97$, $p = .138$).

Student Survey (Q7):

Changes in student response patterns between the pre and post surveys indicate significant increases in the percentage of the grade students report teachers attribute to:

- Group Projects ($\chi^2 = 218.20$, $p < .001$)
- Work that is shared in a meaningful way with an audience outside the classroom ($\chi^2 = 206.30$, $p < .001$)
- Oral Reports and Presentations ($\chi^2 = 172.88$, $p < .001$), and
- Independent Projects ($\chi^2 = 93.15$, $p < .001$).

The pre/post changes were statistically significant, but the direction was not apparent for:

- Class Participation ($\chi^2 = 314.89$, $p < .001$)
- Tests and Quizzes ($\chi^2 = 102.32$, $p < .001$)
- Work that is simply handed in and graded by the teachers ($\chi^2 = 219.15$, $p < .001$), and
- Papers and Written Reports ($\chi^2 = 93.15$, $p = .005082$).

Observations Year One

CFF Observers, in response to the question, "Is there a clear rubric that will be used to assess project work?" answered "yes" 21% of the time during the pre observations, and 31% of the time on the post assessment. This 10% increase indicates that teachers used rubrics more to assess project work.

Observations Year Two

In Year Two, CFF Observers indicated that a clear rubric was used to assess project work 35% of the time during the pre observations, and 55% of the time on the post assessment. This statistically significant ($\chi^2 = 12.083, p = .017$) 20% increase indicates that teachers used rubrics more frequently to assess project work.

Observation Y1 and Y2 Compared

Consistent significant gains across the two years indicate that teachers are using more rubrics to assess project work, which is consistent with the teacher and student survey responses indicating that teachers are basing in increased percentage of the students' grades on project work.

CFF Interview Results

In interviews with project managers they described the products students are creating as "much more complex, certainly many more skills, and actually we were concerned that the instructional pace might slow down, but the instructional pace and the learning has actually gone much more quickly. We have been able to cover more content because of the technology. Students are applying more skills. They are able to do more of their research on their own. In our preliminary assessments and our curriculum-based assessments are indicating higher levels of student achievement and more broad-based. All the students in the content areas where we have CFF are learning much more cross-curricular types of information, so we are really hoping that transfers into formal achievement scores. Our preliminary grades and rubrics and curriculum-based assessments are showing that the students are learning at a much faster and much higher level."

Y2 Conclusions

There is ample evidence across the two years and across surveys, observations, and interviews, that CFF changes the type of products on which students' grades are based, with more emphasis being placed on oral reports and presentations, projects, and group work. There is some evidence of a decline in the prominence placed on tests and quizzes, and the use of clear rubrics to assess project work is increasing.

Section 4: Impact on Teacher Attitudes

Because teacher attitudes are important "early indicators" of how a significant change is going, and because building leaders can use information on attitudes to steer program implementation, this formative assessment investigated teacher attitudes from the perspective of the following eleven questions:

- Do teachers' opinions about the potential value of technology in their classrooms change during their CFF experience?
- Do teachers and key informants believe that the quality of the learning experience they offer has increased as a result of CFF?
- Do teachers believe student learning has increased as a result of CFF?
- Does CFF change the type of work they assign and the quality of work they expect from students?
- Do teachers develop more technology-related skills and feel better prepared to teach using technology?
- Do teachers believe that they are working longer or harder as a result of CFF?
- Does CFF change the way teachers feel about teaching as a profession?
- How important do teachers believe the CFF Coaches to be in the success of CFF?
- Which of the CFF Coach responsibilities do the teachers perceive as most important?
- How important do teachers believe the Building Principal has been in the success of CFF?
- Which of the Building Principal's contributions do the teachers perceive as most important?

Each of these questions is discussed in turn, in the pages below.

Do Teachers' Opinions about the Potential Value of Technology in Their Classrooms Change During Their CFF Experience?

CFF Survey Year One

Teacher Survey (Q8r):

In the Year One pre survey, 74% of teachers reported that the technologies in their classrooms were either "valuable" (46%) or "very valuable" (28%) while 4% of teachers reported that they don't use the technologies and 5% reported the technologies they use to be "not valuable." The change from the pre to post surveys was not statistically significant ($\chi^2 = 5.40$, $p = .248$) with post results indicating that 78% of teachers felt that the technologies in their classrooms were either "valuable" (46%) or "very valuable" (32%), while 3% of teachers reported that they don't use the technologies, and 4% reported the technologies they use to be "not valuable."

Teacher Survey (Q12):

In response to the item, "When we look back on the progress made in teaching your subject ten years from now, the contribution of technologies will be seen as..." the pre

CFF Survey Year Two

Teacher Survey (Q8r):

In Year Two, the "pre" figures were similar, but the perceived increase in value was much larger and statistically significant ($\chi^2 = 408.98$, $p < .001$). In the Y2 pre survey, 75% of teachers reported that the technologies in their classrooms were either "valuable" (47%) or "very valuable" (28%) while 3% of teachers reported that they don't use the technologies and 4% reported the technologies they use to be "not valuable." The change from the pre to post surveys indicated a significant increase in the value they placed on the technologies, with 88% of teachers reporting that the technologies in their classrooms were either "valuable" (50%) or "very valuable" (38%), while 1% of teachers reported that they don't use the technologies, and 42% reported the technologies they use to be "not valuable."

Teacher Survey (Q12):

In Year Two, the pre and post responses

CFF Survey Y1 and Y2 Compared

The difference in Y1 pre and post change patterns representing teacher perceptions of the value of the technologies they used was not significant, but in Y2 there was a strong increase in the perceived value reported by teachers. They were more likely to find the technologies they used valuable or very valuable.

The most likely reasons for significant gains in Year Two might be:

- the increased time that teachers had to work with the technologies
- the additional professional development they received, and
- the combination of more professional development and more time and experience teaching with the technologies.

Teacher Survey (Q12):

As was the case on the above item related to teachers perceptions of the value of technology, teachers perceptions of the value of technology, as represented by their prediction of how important it will be

CFF Survey Year One

Teacher Survey (Q8r):

In the Year One pre survey, 74% of teachers reported that the technologies in their classrooms were either "valuable" (46%) or "very valuable" (28%) while 4% of teachers reported that they don't use the technologies and 5% reported the technologies they use to be "not valuable." The change from the pre to post surveys was not statistically significant ($\text{Chi}^2 = 5.40$, $p = .248$) with post results indicating that 78% of teachers felt that the technologies in their classrooms were either "valuable" (46%) or "very valuable" (32%), while 3% of teachers reported that they don't use the technologies, and 4% reported the technologies they use to be "not valuable."

Teacher Survey (Q12):

In response to the item, "When we look back on the progress made in teaching your subject ten years from now, the contribution of technologies will be seen as..." the pre and post responses were not significantly different, ($\text{Chi}^2 = 0.68$, $p = .954$). On the post survey, approximately 28% predicted

CFF Survey Year Two

Teacher Survey (Q8r):

In Year Two, the "pre" figures were similar, but the perceived increase in value was much larger and statistically significant ($\text{Chi}^2 = 408.98$, $p < .001$). In the Y2 pre survey, 75% of teachers reported that the technologies in their classrooms were either "valuable" (47%) or "very valuable" (28%) while 3% of teachers reported that they don't use the technologies and 4% reported the technologies they use to be "not valuable." The change from the pre to post surveys indicated a significant increase in the value they placed on the technologies, with 88% of teachers reporting that the technologies in their classrooms were either "valuable" (50%) or "very valuable" (38%), while 1% of teachers reported that they don't use the technologies, and 42% reported the technologies they use to be "not valuable."

Teacher Survey (Q12):

In Year Two, the pre and post responses were statistically significantly different, ($\text{Chi}^2 = 20.26$, $p < .001$), with a 43% of teachers predicting technology

CFF Survey Y1 and Y2 Compared

The difference in Y1 pre and post change patterns representing teacher perceptions of the value of the technologies they used was not significant, but in Y2 there was a strong increase in the perceived value reported by teachers. They were more likely to find the technologies they used valuable or very valuable.

The most likely reasons for significant gains in Year Two might be:

- the increased time that teachers had to work with the technologies
- the additional professional development they received, and
- the combination of more professional development and more time and experience teaching with the technologies.

Teacher Survey (Q12):

As was the case on the above item related to teachers perceptions of the value of technology, teachers perceptions of the value of technology, as represented by their prediction of how important it will be in teaching their subjects in 10 years, increased significantly in Y2.

Do Teachers Believe that the Quality of the Learning Experience They Offer has Increased as a Result of CFF?

CFF Survey Year One

Teacher Survey (Q13):

In Year One the pre/post differences in teacher survey responses to the item, "Given the tools and resources available to me, the learning experience I can offer students in my classroom is..." produced patterns of responses that were significantly different between the pre and post assessments ($\chi^2 = 14.71$, $p = .0053$) indicating that teachers believe that as a result of the CFF resources they can provide students with a better education.

Given the tools and resources available to me, the learning experience I can offer students in my classroom is...			
	Pre	Post	Change
Poor	3%	1%	-2%
OK	9%	8%	-1%
Good	23%	19%	-4%
Very good	42%	43%	0%
Excellent	23%	29%	6%

CFF Survey Year Two

Teacher Survey (Q13):

In Year Two the pre/post differences were even more dramatic, producing patterns of responses that were significantly different between the pre and post assessments ($\chi^2 = 337.09$, $p < .001$) indicating, again in Year Two, that teachers believe that as a result of the CFF resources they can provide students with a better education.

Given the tools and resources available to me, the learning experience I can offer students in my classroom is...

	Pre	Post	Change
Poor	2%	1%	-2%
OK	10%	4%	-6%
Good	25%	18%	-6%
Very good	41%	48%	7%
Excellent	22%	29%	7%

At the time of the pre survey, 63% of the teachers rated the education they could offer as "very good" (41%) or "excellent" (22%). By the post survey these numbers had climbed by 14% at the top two levels, to a total of 77% rating the education they could offer as "very good" (48%) or "excellent" (29%).

CFF Survey Y1 and Y2 Compared

Consistently, across the two years, significant increases in teachers' perceptions of the quality of education they could offer their students occurred, with significantly more teachers rating the experience they could offer as excellent to very good.

CFF Interview Results

Principals and project managers have reported that the excitement and interest exhibited by students are indicators that students' learning experience is improved. When asked whether they believed the quality of the learning experience has increased, 96% of the principals and 100% of the project directors responded, "Yes".

A few of those interviewed felt that the quality of the instruction prior to CFF was very good but that the "CFF program really aided in taking that relevant and rigorous curriculum to the next level." Further, "...this grant has allowed us to put a different spin on that learning in the classroom and give them different methods of learning." The change away from lecture-based teaching to more hands-on learning and multiple ways of presenting information is seen as a positive result of the program. As one project manager shared, "We see movement in the classroom; we see activities; we see students who normally may not be interested in what the lesson is, but because it is presented in a new and different way, you see that gleam in their eyes or that gasp of hope, and say, 'Hey, I can do this too.' I think just the presentation and delivery of information has changed completely. I see students who are happy to be in the classroom, and when you walk in and all the laptops are open and the kids are working, you see smiles on their faces, and it just shows you that we've done something well." The participants we interviewed also reported that the products that students are creating are much more complex with students spending much more time on task.

Y2 Conclusions

Do teachers believe that the quality of the learning experience they offer has increased as a result of CFF? Yes. Teacher survey responses to two different items show that they feel that the quality of the education they can offer has increased, and this is substantiated by comments gathered during the interview process.

Does CFF Change the Quality of Work Teachers Expect From Students?

CFF Survey Year One

Teacher Survey (Q14-A-2):

In Year One the pre/post differences in teacher survey responses to the item, "I can expect work of the highest quality from our students" produced patterns of responses that were significantly different between the pre and post assessments ($\chi^2 = 13.92$, $p = .0161$) indicating that teachers' expectations for the quality of student work increased between the CFF pre and post assessments.

I can expect work of the highest quality from our students.			
	Pre	Post	Change
Strongly Disagree	0%	1%	0%
Disagree	3%	2%	-1%
Somewhat Disagree	9%	5%	-3%
Somewhat Agree	29%	27%	-3%
Agree	38%	40%	2%
Strongly Agree	20%	25%	5%

CFF Survey Year Two

Teacher Survey (Q14-A-2):

In Year Two the pre/post survey responses were also statistically significantly different ($\chi^2 = 39.55$, $p < .001$) indicating, again in Year Two, that teachers' expectations for the quality of student work increased between the CFF pre and post assessments.

I can expect work of the highest quality from our students.			
	Pre	Post	Change
Strongly Disagree	1%	1%	0%
Disagree	2%	2%	-1%
Somewhat Disagree	7%	6%	-1%
Somewhat Agree	31%	27%	-4%
Agree	38%	41%	3%
Strongly Agree	21%	23%	2%

CFF Survey Y1 and Y2 Compared

Consistently, across Years One and Two, teachers' expectations for the quality of student work increased, with almost 2/3 of teachers (64%) either agreeing (41%) or strongly agreeing (23%) that they can expect the highest quality work from their students.

CFF Interview Results

In interviews with principals and project managers about the CFF program, they reported that a lot more time is being devoted to project-based learning and hands-on activities. They report that students are spending more time working at their own pace and using higher-order thinking skills. One project manager reported that, “Students are engaged from three-fourths to ninety percent of the classroom time. They are dialoging. They are creating. They are collaborating. They are analyzing to a much higher level and to a greater extent.” They also found that there was much more teacher collaboration in planning among core academic departments.

Y2 Conclusions

CFF does appear to influence teachers' expectations with regard to the quality of work they can expect from students. Teachers' expectations for the quality of student work increased during each of the two CFF years, with almost two-thirds of teachers (64%) either agreeing (41%) or strongly agreeing (23%) that they can expect the highest quality work from their students.

Do Teachers Develop More Technology-Related Skills and Feel Better Prepared to Teach Using Technology?

CFF Survey Year One

Teacher Survey (Q14-A-7):

In Year One the pre/post differences in teacher survey responses to the item, "I have the technology skills I need to teach my subject using the best methods available" produced patterns of responses that approached but did not reach the level associated with statistical significance ($\chi^2 = 10.15$, $p = .0711$). The trend was in the anticipated direction, with decreases at the lower levels of agreement, and an increase in the "agree" category.

I have the technology skills I need to teach my subject using the best methods available.			
	Pre	Post	Change
Strongly Disagree	5%	3%	-2%
Disagree	7%	6%	-1%
Somewhat Disagree	13%	11%	-2%
Somewhat Agree	30%	28%	-2%
Agree	29%	36%	7%
Strongly Agree	16%	16%	0%

CFF Survey Year Two

Teacher Survey (Q14-A-7):

In Year Two the pre/post survey responses were statistically significantly different ($\chi^2 = 270.46$, $p < .001$) indicating that in year two teachers' estimates of their work-related technology skills had increased between the CFF pre and post assessments.

I have the technology skills I need to teach my subject using the best methods available.			
	Pre	Post	Change
Strongly Disagree	3%	2%	-2%
Disagree	9%	4%	-4%
Somewhat Disagree	14%	9%	-4%
Somewhat Agree	31%	30%	0%
Agree	29%	38%	9%
Strongly Agree	14%	17%	3%

At the time of the pre survey, 43% of the teachers agreed (29%) or strongly agreed (14%). By the post survey these numbers had climbed by 12% at the top two levels, to a total of 56% agreeing or strongly

CFF Survey Y1 and Y2 Compared

The change in teachers' perceptions of their technology skills was not statistically significant in Year One, but it was in Year Two.

This *may* be due to the longer implementation period in Year Two, or it may be due to the cumulative effects of access to the technologies and professional development experienced by CFF "cohort one" teachers, who had been in the program for two years by the time of the Y2 post survey.

As for teacher perceptions of their preparedness to teach, the evidence is not compelling that CFF makes a difference in this respect. The results in Year One failed to reach the level of statistical significance, and in Year Two the results were statistically significant, but due to a series of very small shifts.

Although the pre and post responses were only marginally different, it is important to note that almost three-fourths of the

Teacher Survey (Q14-A-3):

In Year One the pre/post differences in teacher survey responses to the item, "I feel better prepared to teach than I did last year." produced patterns of responses that did not reach the level associated with statistical significance ($\chi^2 = 8.08$, $p = .1518$). The trend was in the anticipated direction, with decreases at the lower levels of agreement, and an increase in the "agree" category.

I feel better prepared to teach than I did last year.			
	Pre	Post	Change
Strongly Disagree	1%	1%	0%
Disagree	3%	3%	-1%
Somewhat Disagree	7%	4%	-3%
Somewhat Agree	20%	19%	0%
Agree	38%	42%	4%
Strongly Agree	31%	31%	0%

agreeing that they had the technology skills needed to teach their subjects using the best methods available.

Teacher Survey (Q14-A-3):

The Y2 responses to the pre/post teacher survey for to the item, "I feel better prepared to teach than I did last year," produced patterns of responses were statistically significantly different ($\chi^2 = 14.58$, $p = .01231$). The change was caused by a series of very small changes (all 1%) in the anticipated direction, with decreases at the lower levels of agreement, and increases in the "agree" and strongly agree categories.

I feel better prepared to teach than I did last year.			
	Pre	Post	Change
Strongly Disagree	1%	1%	0%
Disagree	4%	3%	0%
Somewhat Disagree	5%	4%	-1%
Somewhat Agree	19%	18%	-1%
Agree	42%	43%	1%
Strongly Agree	29%	30%	1%

teachers responding, in both Years One and Two (73%) either agreed or strongly agreed that they were better prepared to teach than the previous year.

CFF teachers' responses to the PATI survey also indicate that CFF teachers are more comfortable with technology use to gather, analyze, and interpret data than non-CFF teachers.

PATI Survey (Q19-A-3):

Additional evidence concerning CFF teachers' level of comfort and proficiency with technology use to gather, analyze and interpret data can be found in the question below from the PATI survey. When we compare the responses given by CFF teachers and non-CFF teachers we see that CFF teachers have a much greater level of comfort with the use of technology for these purposes. ($\chi^2 = 147.29$, $p < .001$)

I feel comfortable using technology to help gather, analyze, and interpret data on student progress (for example, by graphing trends in achievement, or using hand-held computers to collect data on students as they are learning).

	CFF Teacher %	Non CFF Teacher %	Diff.
Strongly Agree	74.70	66.00	8.70
Agree	20.90	26.30	-5.40
Disagree	3.40	5.30	-1.90
Strongly Disagree	0.80	2.10	-1.30

CFF Interview Results

Principals and project directors reported seeing some real changes in teacher skills and attitudes with regard to teaching with technology. As noted previously, they reported teacher attitudes as overwhelmingly positive (51%). One principal reported that, “Integrating use of technology into the classroom is to the highest level I have ever observed. Never in my career have I seen any program that has had such impact on student learning. Teachers are on fire, they are collaborating, exploring together, and kids are more empowered. They have an opportunity to help their teachers.” In another example, a project manager shared that, “The students are excited about the technology. There has been a degree of respect instilled in them by the teachers so that it is more than just a toy. It is an active part of the classroom and the teachers have really done a good job to incorporate this. And they have been excited about the potential of what this technology can do for them within the classroom environment.”

Y2 Conclusions

There is evidence from the teacher surveys in Year Two that teachers develop more technology-related skills as a result of CFF. They tend to feel that they have the technology skills they need to teach their subjects using the best methods. However, the little evidence for the proposition that CFF is causing teachers to feel better prepared to teach is not compelling. This could be because as teachers develop technology-related skills they see new ways to approach teaching, and so the goal (having the tech skills they need) moves back as they approach it. CFF teachers are more comfortable working with technologies than their non-CFF counterparts, but that finding should be interpreted with caution, as the mix of subjects taught is different in the CFF and non-CFF teacher populations.

Does Teachers Believe that They are Working Longer or Harder as a Result of CFF?

CFF Survey Year One

Teacher Survey (Q14-A-4):

The pre/post changes indicating whether teachers feel that they are working harder than in past years were not statistically significantly different ($\chi^2 = 7.13$, $p = .211$). It should be noted, however that 90% of teachers are on the "Agree" side of the scale, indicating that they do feel that they are working harder than in past years, even at the time of the "pre" assessment.

I am working HARDER than I have in past years.			
	Pre	Post	Change
Strongly Disagree	1%	1%	0%
Disagree	3%	2%	-1%
Somewhat Disagree	6%	6%	-1%
Somewhat Agree	21%	17%	-4%
Agree	34%	35%	1%
Strongly Agree	35%	39%	4%

Teacher Survey (Q14-A-4):

A similar item indicated no statistically significant difference between the response patterns at the pre and post assessments

CFF Survey Year Two

Teacher Survey (Q14-A-4):

The patterns of small but statistically significant pre/post differences indicated in the table below indicate that teachers were slightly more likely to report that they were working harder than in past years, at the end of the CFF year than at the beginning ($\chi^2 = 17.33$, $p = .00391$).

I am working HARDER than I have in past years.			
	Pre	Post	Change
Strongly Disagree	1%	0%	0%
Disagree	3%	3%	-1%
Somewhat Disagree	8%	6%	-1%
Somewhat Agree	20%	20%	0%
Agree	34%	35%	1%
Strongly Agree	35%	36%	1%

Teacher Survey (Q14-A-5):

A similar pattern of small but systematic differences in the table below indicates that teachers were also more likely to report that they were working longer than in past years ($\chi^2 = 32.13$, $p < .001$).

CFF Survey Y1 and Y2 Compared

The pre/post differences were not significant in Year One, but they were in Year Two, indicating that Y2 CFF teachers felt increasingly that they were working longer and harder than in past years. Perhaps more important, though, is the fact that large percentages of teachers reported this, both at the pre and post assessments and in both Year One and Year Two.

CFF Survey Year One

Teacher Survey (Q14-A-4):

The pre/post changes indicating whether teachers feel that they are working harder than in past years were not statistically significantly different ($\chi^2 = 7.13$, $p = .211$). It should be noted, however that 90% of teachers are on the "Agree" side of the scale, indicating that they do feel that they are working harder than in past years, even at the time of the "pre" assessment.

I am working HARDER than I have in past years.			
	Pre	Post	Change
Strongly Disagree	1%	1%	0%
Disagree	3%	2%	-1%
Somewhat Disagree	6%	6%	-1%
Somewhat Agree	21%	17%	-4%
Agree	34%	35%	1%
Strongly Agree	35%	39%	4%

Teacher Survey (Q14-A-4):

A similar item indicated no statistically significant difference between the response patterns at the pre and post assessments

CFF Survey Year Two

Teacher Survey (Q14-A-4):

The patterns of small but statistically significant pre/post differences indicated in the table below indicate that teachers were slightly more likely to report that they were working harder than in past years, at the end of the CFF year than at the beginning ($\chi^2 = 17.33$, $p = .00391$).

I am working HARDER than I have in past years.			
	Pre	Post	Change
Strongly Disagree	1%	0%	0%
Disagree	3%	3%	-1%
Somewhat Disagree	8%	6%	-1%
Somewhat Agree	20%	20%	0%
Agree	34%	35%	1%
Strongly Agree	35%	36%	1%

Teacher Survey (Q14-A-5):

A similar pattern of small but systematic differences in the table below indicates that teachers were also more likely to report that they were working longer than

CFF Survey Y1 and Y2 Compared

The pre/post differences were not significant in Year One, but they were in Year Two, indicating that Y2 CFF teachers felt increasingly that they were working longer and harder than in past years. Perhaps more important, though, is the fact that large percentages of teachers reported this, both at the pre and post assessments and in both Year One and Year Two.

Y2 Conclusions

The pre/post differences were statistically significant in year two, indicating that a small but real shift in perceptions occurred and that teachers felt that they were working longer and harder than they had in previous years. However, perhaps more important than the small but significant shift is the fact that large numbers of teachers believed they were working longer and harder at the time of the pre AND post assessments, in both Years One and Two.

Leaders of the CFF and other school reform efforts should be aware of this perception, as it may be an important fact as we ask teachers to invest additional time and energy.

Does CFF Change the Way Teachers Feel about Teaching as a Profession?

CFF Survey Year One

Teacher Survey Q14-A-6:

Teachers were asked to express their level of agreement with the statement, "I would recommend teaching to a friend considering entering the profession." The pre/post differences were not statistically significant ($\text{Chi}^2 = 4.34$, $p = .502$).

More than half of the CFF teachers (53%) either agreed (34%) or strongly agreed (19%) with the statement.

CFF Survey Year Two

Teacher Survey Q14-A-6:

As was the case in Year One, the Year Two pre/post differences were not statistically significant ($\text{Chi}^2 = 9.78$, $p = .088$).

Half of the CFF teachers (50%) either agreed (32%) or strongly agreed (18%) with the statement.

CFF Survey Y1 and Y2 Compared

The results were consistent across the two years.

There is no evidence from the teacher surveys that CFF changes the way that teachers feel about teaching as a profession.

CFF Interview Results

The project managers interviewed reported seeing a change in teachers' instructional practice. One project manager described a change from a minimal degree of academic competition in the school [gifted education] to a renewed interest by the math and science education teachers to create an academic competition that they want to sustain year after year. He states that, "Before, teachers would not stay after school. Now, because of the competition they have initiated, they stay late working with kids. We are seeing a connection. They were speaking from the podium in front of the class; now they are facilitators walking around the room. The atmosphere in the building has changed."

Y2 Conclusions

There is no evidence that CFF changes the way that teachers feel about teaching as a profession, but there have been stories told during the interviews indicating that CFF has had a positive effect on certain teachers, including reports of more teachers staying late in the day, working weekends, and even considering postponing retirement.

How Important Do Teachers Believe the CFF Coaches to Be in the Success of CFF?

CFF Survey Year One

Teacher Survey (Q15-A-9):

By the time the pre survey window opened on February 2, the coaches had already proven their value to most teachers, as two-thirds of the CFF teachers reported finding them either "valuable" or "very valuable" to the success of the CFF program at their schools. By the post survey period, that number had grown an additional 8%, to almost three-fourths, and a statistically significant pattern of pre/post differences ($\chi^2 = 39.86$, $p < .001$) emerged, as 12% fewer said that the question was not applicable to them (probably as the coaches began to work with them).

Overall, how important is the CFF Coach to the success of your school's CFF effort?			
	Pre	Post	Change
N/A	20%	8%	-12%
Not Valuable	4%	6%	2%
Little value	10%	12%	2%
Valuable	33%	39%	7%
Very Valuable	33%	34%	1%

CFF Survey Year Two

Teacher Survey (Q15-A-9):

The pre survey window opened much earlier in Year Two, on the last day of October, and despite the earlier start the coaches had again proven their value, as 61% of the CFF teachers reported finding them either "valuable" or "very valuable" to the success of the CFF program. By the post survey period, that number had grown an additional 15%, to just over three-fourths, and a statistically significant pattern of pre/post differences ($\chi^2 = 1333.86$, $p < .001$) emerged, as 24% fewer said that the question was not applicable to them.

Overall, how important is the CFF Coach to the success of your school's CFF effort?			
	Pre	Post	Change
N/A	29%	4%	-24%
Not Valuable	4%	7%	4%
Little value	7%	13%	6%
Valuable	31%	40%	9%
Very Valuable	30%	36%	6%

CFF Survey Y1 and Y2 Compared

In both Years One and Two, most CFF teachers rated their CFF coaches as either valuable or very valuable to the success of the program at the time of the pre assessment, and in both years the pre/post changes were significant, indicating that as more teachers worked with the coaches more understood the value they add to the program.

CFF Interview Results

Our interview data indicates that the coach's role in the CFF program has been invaluable in creating an environment where teachers can feel comfortable with the technology. We heard many testimonials about coaches supporting teachers as they explore new ways of teaching, and help teachers to actively engage students in learning. According to the principals, project managers and technology directors interviewed, the coaches are critical to the success of the program. Words describing the coach in the interviews included: invaluable, outstanding, indispensable, instrumental, catalyst, resource, and critical. One project manager explained the coach's role, saying, "The coach is the success of all of this. Having a coach who is a teacher is the ideal experience because they are the ones on the front edge; they are on the cutting edge of integrating this technology into the lessons. And then they serve as a model for other teachers as well as the facilitator of other teachers to try different instructional processes. So the coach has been crucial to all of this." Another noted that, "Our coach is invaluable. She has been an unbelievable help to the teachers. She is one of the best resources to ever come out of any grant or program, ever."

Y2 Conclusions

Approximately 75% of the teachers believe that their coaches are either valuable (40%) or very valuable (36%) to the program's success in their schools, and the interviews with other program leaders make an even stronger case for the value of the coaches. It seems safe to conclude that without the coaches progress it would be much slower than we see as a result of their efforts.

Which of the CFF Coaches' Responsibilities Do the Teachers Perceive as Most Important?

Indicate how valuable each of the various activities performed by the Classrooms for the Future Coaches have been to you. (1= Highest Ranking)	YEAR ONE		YEAR TWO		<u>CFF Survey Y1 and Y2 Compared</u> Teachers were asked to rate each of the Coach services in the table at the left according to its level of value. (See Appendix C, Tables Q15 for details.) To determine the services most valued, we added the percentages of teachers who rated each service as valuable or very valuable, and then ranked the highest total "1" to indicate the top priority, and proceeded to rank the other services in order by totals. Ranks are shared to indicate two services receiving the same totals, and the next rank was omitted. As illustrated in the table to the left, the ratings were quite consistent. The most valuable Coach responsibility overall was "Suggesting ways to incorporate technology to teach the content in my classes."
	PRE Value Ranking	POST Value Ranking	PRE Value Ranking	POST Value Ranking	
Teaching me to operate computers, networks, or software programs	1	1	2	2	
Suggesting ways to incorporate technology to teach the content in my classes	2	1	1	1	
Solving technical problems (printer won't print, network is down, etc.)	3	4	4	4	
Leading CFF-related professional development workshops	4	3	3	3	
Helping me think about how to assess technology-rich lessons	5	5	5	5	
Advising me on how to use technology through a differentiated instruction approach to meet individual student needs	6	6	6	5	
Observing my instruction and providing feedback	7	7	7	8	
Teaching demonstration lessons in my classroom	8	8	7	7	

CFF Interview Results

Overwhelmingly, the project managers interviewed reported that working one-on-one with teachers and modeling technology are the most important responsibilities of the coaches. One project manager noted that, “The reason my grant was so successful was that our coach had that designated time to go into the classrooms to work with those teachers one-on-one and to model the technology, to brainstorm, to work with them, and problem-solve.” In other comments project managers talked about the importance of relationships between teachers and the coach, sharing ideas, and interacting with teachers in a non-threatening way. The principals interviewed viewed the importance of their role more broadly. They identified working one-on-one with teachers, providing professional development, and encouraging teaching in implementing the technology as the primary responsibilities, with additional factors including being approachable and available, providing technical support, communication, and collaboration/co-teaching.

Y2 Conclusions

The top two most valued services provided by the coaches, suggesting ways or the CFF teachers to incorporate technology to teach the content in their classes and teaching them to operate computers, networks, or software programs, are duties that seem to fall within the Coach's domain of responsibilities. However, the third most valued service is a service that should probably be delegated to the technology support personnel, to free up time for coaching to take place.

How Important Do Teachers Believe the Building Principal has Been in the Success of CFF?

CFF Survey Year One

Overall, how important has your building principal been to the success of your school's CFF effort?			
	Pre	Post	Change
N/A	35%	27%	-8%
Not Valuable	11%	13%	2%
Little value	15%	18%	3%
Valuable	28%	31%	3%
Very Valuable	11%	11%	0%

Large percentages of teachers chose "not applicable" in response to this question, perhaps due to the fact that they may not have been aware of ways in which the principal was contributing. However, large percentages also found the principal's contributions valuable (31%) or very valuable (11%). It is quite possible that these numbers indicate the fact that some principals are very supportive, while others are not.

The pre/post differences were statistically significant ($\chi^2 = 12.25$, $p = .0158$), but this is probably a reflection of the large percentage moving out of the N/A category as the teachers have more opportunity to understand the principal's contributions.

CFF Survey Year Two

Overall, how important has your building principal been to the success of your school's CFF effort?			
	Pre	Post	Change
N/A	34%	23%	-12%
Not Valuable	9%	14%	6%
Little value	13%	19%	6%
Valuable	30%	33%	3%
Very Valuable	14%	11%	-3%

As was the case in Year One, large percentages of teachers chose "not applicable" in response to this question, and large percentages also found the principal's contributions valuable (33%) or very valuable (11%).

The pre/post differences were statistically significant ($\chi^2 = 330.36$, $p < .001$), but this is probably a reflection of the large percentage moving out of the N/A category since the gains are spread across the other categories.

CFF Survey Y1 and Y2 Compared

Based on the consistency of the data on this item across pre and post surveys and across Years One and Two, it seems quite possible that these numbers indicate the fact that some principals are very supportive, while others are not.

It should also be noted, however, that the fact that many teachers do not have the opportunity to see the principal in a supportive role, does not mean that the support is not happening.

CFF Interview Results

In interviews with technology directors and project managers about the principal's role in the success of CFF, they reported overall that they were very supportive of the program by being an advocate, making the goals of CFF a priority, and supporting its implementation. As one project manager responded, "The administrator is right on board with everything. He was kind of, how to say 'backward' at first and thought we should just utilize it in one classroom and see how it went. But he admits he was wrong, and like you said, it's like a wildfire that went across our school from one classroom to the next." The administrators provided time for teachers to engage in professional development, locating additional resources for technology, and allowing teachers to experiment without fear of the administrator looking over their shoulder. They understand the importance of the program as one project manager shared, "So there has been a sense that this can be the thing that can push along classroom reform and atmosphere here."

Y2 Conclusions

Based on the data we have from surveys and interviews, it seems plausible that principals differ widely in terms of the amount of support they provide for the CFF program and the value of their efforts. We heard numerous reports of principals who play a crucial role, and many teachers acknowledged this in their survey responses. However, the numerous survey responses attributing little or no value to the principal is reason to believe that there are locations in which principals are not contributing in a large or noticeable way.

Which of the Building Principal's Contributions Do the Teachers Perceive as Most Important?

<u>CFF Survey Year One and Two</u>					<u>CFF Survey Y1 and Y2 Compared</u>
Indicate how valuable each of the various activities performed by the Classrooms for the Future Principals have been to you. (1= Highest Ranking)	YEAR ONE		YEAR TWO		The ratings from Years One and Two, displayed in the table to the left, are remarkably consistent, as were the data from which the ranks were created. The two most valued services CFF principals provide are observing CFF lessons and providing feedback, and suggesting ways to incorporate technologies to teach the content in CFF teachers' classes.
	PRE Value Ranking	POST Value Ranking	PRE Value Ranking	POST Value Ranking	
Observing my instruction and providing feedback	1	1	1	1	
Suggesting ways to incorporate technology to teach the content in my classes	2	2	2	2	
Advising me on how to use technology through a differentiated instruction approach to meet individual student needs	3	3	3	3	
Helping me think about how to assess technology-rich lessons	3	4	3	3	
Teaching demonstration lessons in my classroom	5	5	5	5	

CFF Interview Results

Several interviews have cited important roles for the principals. One project manager noted, "The building administrator has helped the program by supporting the teachers in what they are trying to do through frequent walk-through visits in the classroom, working with them on their embedded learning and group work, and providing time for them to meet, setting up where the coach is in the same hallway with the teachers she is working with." This is consistent with what teachers report in the surveys.

Y2 Conclusions

The two most valued services CFF principals provide are observing CFF lessons and providing feedback, and suggesting ways to incorporate technologies to teach the content in CFF teachers' classes.

Section 5: Impact on Student Attitudes

Because student attitudes play a very important role in student achievement, the contributors to the design of this evaluation wanted to monitor how students feel, as well as how teachers feel. Specifically, we wanted to know:

- Do students believe that the quality of the learning experience offered has increased as a result of CFF?
- Do students' opinions about the value of school change as a result of their CFF experience?
- Does student interest increase in math, science, language arts or social science?
- Does CFF influence students' perceptions of their preparation for college and for life after school?
- Does CFF influence students' interest in teaching as a career?
- Do students believe that they are working longer or harder due to CFF?

Since students are the best source of information on how students feel, the research team decided to rely principally on evidence from student surveys (pre and post) to address these questions. In our Year Two evaluation, each CFF teacher was asked to have one class of students respond to the CFF Student Survey.

This resulted in survey responses from very large numbers of students -- 96,780 students during the pre survey window and 89,302 students during the post window. With numbers this large, even very small changes tend to result in "statistically significant" findings, and it becomes necessary to think also in terms of "practical significance." In other words, what degree of change might be required to make a difference, to influence student achievement or other important variables? For this reason, we will describe statistically significant findings with changes less than 3% as "significant, but very small" differences, and may not go into detailed explanations of the minor shifts from category to category. It is also possible to have patterns of very small changes that are significant, but not in an identifiable direction, for example with a 1% increase in "strongly agree," a 1% drop in "agree," a 1% increase in "neutral," and a 1% loss in "disagree." In such cases, we will indicate that a significant difference in the patterns exist, but will not attribute a direction to the change.

Do Students Believe that the Quality of the Learning Experience Offered has Increased as a Result of CFF?

CFF Survey Year One

Student Survey (Q1):

In the Year One pre student surveys, 73% of CFF students agreed or strongly agreed with the statement: "My classes are helping me build skills like how to work independently, how to research online, how to work as part of a team, etc., that will help me be successful in the modern workplace." Four percent more students strongly agreed with that statement at the post survey stage (a change from 22% to 25%) and 3% fewer agreed (a change from 52% to 49%). One percent fewer students were neutral and 1% fewer disagreed. This pattern of differences indicating changing student perceptions indicating that students feel more strongly that school is developing important skills was statistically significant ($\chi^2 = 33.43$, $p < .001$).

CFF Survey Year Two

Student Survey (Q1):

As was the case in Year One, the Year Two student survey showed 73% of students either agreeing or strongly agreeing that their classes are helping them build important skills. On the Y2 post survey, again 73% chose these two categories, but 3% who had agreed moved to strongly agree. There was also a small (15) decrease in the number of students who responded with "neutral" and a 1% increase of students responding "strongly disagree." This pattern of pre/post differences indicating that students feel more strongly that the school is developing important skills was statistically significant ($\chi^2 = 294.68$, $p < .001$).

Student Survey (Q8-o):

This question, added on Year Two, asked students to agree or disagree with the statement, "This school is providing me with a quality education." Sixty percent of students either agreed (39%) or strongly agreed (21%) on the pre survey, but that number had dropped to 55% (36% agree, 19% strongly agree) on the post survey. Three percent more students were neutral and 1% more chose "strongly disagree" on the post than on the pre survey. This statistically significant pattern of differences, although small, indicates that students were, at the end of the academic year, less likely to feel that they were getting a quality education.

CFF Survey Y1 and Y2

Compared

Student Survey (Q1):

Both Years One and Two indicate that student perceptions of the value of school are increasing, with more students tending to strongly agree that schools are preparing them well.

Y2 Conclusions

The evidence designed to address the question, "Do students believe that the quality of the learning experience offered has increased as a result of CFF?" is mixed. Students answered the question about the development of crucial skills more favorably at the end of the year, but they answered the question about the school providing them a high quality education less favorably.

Although our data do not allow us to resolve this with confidence, one possible explanation might be that students, as a result of CFF, *are* more likely to be developing skills that will be important in their future, but at the same time the fact that they are not using the CFF equipment extensively might be causing them to realize that the quality of the education they are receiving is less than optimal, dropping their assessment of the quality of their educational experience. (Thirty-nine percent of CFF teachers and 15% of CFF students reported that students use computers 20% of the time, or less)

Do Students' Opinions about the Value of School Change as a Result of Their CFF Experience?

CFF Survey Year One

Student Survey (Q8-b):

"I am proud of my school."

Very small changes from category to category (all 1%), but producing a statistically significant pattern of differences showing a slight shift toward agreement, with approximately 30% agreeing, 18% strongly agreeing, and 10% strongly disagreeing on the post survey.

Student Survey (Q8-c):

"I get excited about going to school."

This item, too, indicated small but significant positive changes in student attitudes toward school, with increases in the strongly agree (up 2% to 10%), agree (up 3% to 18%), and a 1% increase in "neutral" responses, and with corresponding drops in negative categories.

Student Survey (Q8-d):

"I put more effort into school this year."

The small but significant changes in this item from pre-to-post surveys revealed a slightly negative trend, with a 4% drop in the "agree" category and 3% and 1% gains

CFF Survey Year Two

Student Survey (Q8-b):

"I am proud of my school."

A significant pattern of small shifts (2% or less) indicate a slight drop in school pride, with a 2% drop in the strongly agree category (to 18%) and a 1% drop in the agree category (to 31%), and a 2% increase in "neutral" responses.

Student Survey (Q8-c):

"I get excited about going to school."

Very small but significant shifts occurred in Y2 as well, with a 1% increase in strongly agree and a 1% decrease in those responding "disagree."

Student Survey (Q8-d):

"I put more effort into school this year."

As was the case in Year One, relatively small but significant changes in this item from pre-to-post surveys revealed a downward trend, with a 4% drop in the "strongly agree" category, and a 5% drop in the "agree" category. Corresponding gains were experienced in the "neutral" category (4%), the "disagree" category (3%) and the strongly disagree category

CFF Survey Y1 and Y2 Compared

Student Survey (Q8-b):

"I am proud of my school."

The shifts in both years are statistically significant, but very small. In Y1 they were slightly positive while in Y2 they were slightly negative.

Student Survey (Q8-c):

"I get excited about going to school."

As was mentioned in the Y1 report, this item may have been too strongly worded for high school students. (Being "excited" is not something that students of this age like to admit.) However, the item does reveal small, but consistent changes across the two years, indicating that school may have been more interesting after CFF than before.

Student Survey (Q8-d):

"I put more effort into school this year."

In both Year One and Two, the percentages of students reporting putting more effort into school dropped between the pre and post surveys, but in both years the majority of students agreed or strongly agreed with this item. It is possible that

CFF Survey Year One

Student Survey (Q8-b):

"I am proud of my school."

Very small changes from category to category (all 1%), but producing a statistically significant pattern of differences showing a slight shift toward agreement, with approximately 30% agreeing, 18% strongly agreeing, and 10% strongly disagreeing on the post survey.

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Student Survey (Q8-d):

"I put more effort into school this year."

The small but significant changes in this item from pre-to-post surveys revealed a slightly negative trend with a 4% drop in

CFF Survey Year Two

Student Survey (Q8-b):

"I am proud of my school."

A significant pattern of small shifts (2% or less) indicate a slight drop in school pride, with a 2% drop in the strongly agree category (to 18%) and a 1% drop in the agree category (to 31%), and a 2% increase in "neutral" responses.

Student Survey (Q8-c):

"I get excited about going to school."

Very small but significant shifts occurred in Y2 as well, with a 1% increase in strongly agree and a 1% decrease in those responding "disagree."

Student Survey (Q8-d):

"I put more effort into school this year."

As was the case in Year One, relatively small but significant changes in this item from pre-to-post surveys revealed a downward trend, with a 4% drop in the "strongly agree" category, and a 5% drop in the "agree" category. Corresponding gains were experienced in the "neutral" category (4%) the "disagree" category

CFF Survey Y1 and Y2 Compared

Student Survey (Q8-b):

"I am proud of my school."

The shifts in both years are statistically significant, but very small. In Y1 they were slightly positive while in Y2 they were slightly negative.

Student Survey (Q8-c):

"I get excited about going to school."

As was mentioned in the Y1 report, this item may have been too strongly worded for high school students. (Being "excited" is not something that students of this age like to admit.) However, the item does reveal small, but consistent changes across the two years, indicating that school may have been more interesting after CFF than before.

Student Survey (Q8-d):

"I put more effort into school this year."

In both Year One and Two, the percentages of students reporting putting more effort into school dropped between the pre and post surveys, but in both years the majority of students agreed or strongly

Does Student Interest in Math, Science, Language Arts, and Social Studies Increase as a Result of CFF?

CFF Survey Year One

Student Surveys Q9a-d:

In Year One, differences in the patterns of responses to the pre and post surveys indicated that interest in Reading / English Language Arts increased significantly, with a 3% increase reported in the "most highly interested category," and corresponding drops of 3% and 1% in the "a little interested" and "not at all interested" categories, respectively. ($\chi^2 = 33.42$, $p < .001$)

No significant changes in interest were found for mathematics, science, or social studies.

CFF Survey Year Two

Student Surveys Q9a-d:

Although all of the survey items related to student interest in the four core subject areas produced statistically significantly different patterns between the pre and post surveys, all shifts between categories were very small, 2% or less. It seems that the most accurate conclusion to draw from these analyses is that there is no evidence indicating an increase in interest in the subject areas being studied.

It should also be noted that all students responded to their interest in all four subjects, even if they were only in a CFF classroom for one subject.

CFF Survey Y1 and Y2

Compared

Student Surveys Q9a-d:

The most appropriate conclusion to draw from these analyses is that there is no evidence indicating an increase in interest in the subject areas being studied.

CFF Interview Results

In looking at whether student interest in CFF subject areas has increased, the project managers interviewed believed that students are more engaged in relevant classroom activities, stating, "There is greater participation in every class. What they're doing, in their own mind, is more fun. More than if you just have a paper and pencil... it's more engaging, it's more fun, it's more relevant to life. This makes more sense to them." They are also seeing students working in groups outside the classroom to complete projects and greater teacher/student collaboration. Another stated, "When they come in and find out that the lesson that day is going to involve using the technology, they are very excited and eager to do it." In one case a science teacher told the story of a student who "shot from a C to an A by showing his knowledge through the use of technology."

Y2 Conclusions

Does Student Interest in Math, Science, Language Arts, and Social Studies Increase as a Result of CFF? There is no evidence indicating an increase in interest in the subject areas being studied.

Does CFF Influence Students' Perceptions of their Preparation for College and Life after School?

CFF Survey Year One

Student Surveys (Q8f):

"I feel more confident about life after High School."

A statistically significant change ($\chi^2 = 13.31$, $p = .012$) produced by very small shifts among response categories was characterized by a **shift toward "neutral."** A 2% increase in neutral responses was made possible by 1% drops in both "agree" and "disagree."

Student Surveys (Q8g):

"I feel ready for the real world, with reference to my technology skills."

A statistically significant change ($\chi^2 = 18.03$, $p = .00122$) in pre and post survey response patterns revealed a series of very small shifts including a 2% increase in neutral responses and a 1% increase in "strongly disagree," made possible by 1% drops in both "agree" and "disagree." These shifts across the categories are so small and scattered that they **do not indicate a directional change** with regard to students' perceptions about their readiness for the world beyond school.

CFF Survey Year Two

Student Surveys (Q8f):

"I feel more confident about life after High School."

A statistically significant change ($\chi^2 = 118.01$, $p < .001$) produced by very small shifts among response categories was characterized by a **bipolar shift of 1% toward both "strongly agree" and "strongly disagree."** Corresponding shifts (1% decreases) in "neutral" and "disagree" made the increases at the extremes possible.

Student Surveys (Q8g):

"I feel ready for the real world, with reference to my technology skills."

A statistically significant change ($\chi^2 = 193.75$, $p < .001$) indicate that **students are more likely to report feeling ready for the real world with respect to their technology skills.** A 2% increase in "strongly agree" responses was balanced by a 2% decrease of those who "disagree." On the Y2 post survey, 55% of the students either strongly agreed (20%) or agreed (35%), with 32% neutral and a total of only 12% either disagreeing (8%) or strongly disagreeing (4%).

CFF Survey Y1 and Y2 Compared

Student Surveys (Q8f):

"I feel more confident about life after High School."

The patterns exhibited in Y1 and Y2 were different, With Y1 patterns indicating a shift toward neutral and Y2 indicating a shift toward the extremes. However, all shifts were small and neither pattern indicated movement in a particular direction, so it seems safe to say that CFF does not appear to be having influence on students' confidence about life after school.

Student Surveys (Q8g):

"I feel ready for the real world, with reference to my technology skills."

The majority of students (55%) feel confident in their technology skills and CFF seems to have increased this confidence slightly in Year Two.

Student Surveys (Q8h):

"The work I am doing in my classes will be useful to me in the job I hope to have as an adult."

CFF Survey Year One

Student Surveys (Q8f):

"I feel more confident about life after High School."

A statistically significant change ($\chi^2 = 13.31$, $p = .012$) produced by very small shifts among response categories was characterized by a **shift toward "neutral."** A 2% increase in neutral responses was made possible by 1% drops in both "agree" and "disagree."

Student Surveys (Q8g):

"I feel ready for the real world, with reference to my technology skills."

A statistically significant change ($\chi^2 = 18.03$, $p = .00122$) in pre and post survey response patterns revealed a series of very small shifts including a 2% increase in neutral responses and a 1% increase in "strongly disagree," made possible by 1% drops in both "agree" and "disagree." These shifts across the categories are so small and scattered that they **do not indicate a directional change** with regard to students' perceptions about their readiness for the world beyond school.

CFF Survey Year Two

Student Surveys (Q8f):

"I feel more confident about life after High School."

A statistically significant change ($\chi^2 = 118.01$, $p < .001$) produced by very small shifts among response categories was characterized by a **bipolar shift of 1% toward both "strongly agree" and "strongly disagree."** Corresponding shifts (1% decreases) in "neutral" and "disagree" made the increases at the extremes possible.

Student Surveys (Q8g):

"I feel ready for the real world, with reference to my technology skills."

A statistically significant change ($\chi^2 = 193.75$, $p < .001$) indicate that **students are more likely to report feeling ready for the real world with respect to their technology skills.** A 2% increase in "strongly agree" responses was balanced by a 2% decrease of those who "disagree." On the Y2 post survey, 55% of the students either strongly agreed (20%) or agreed (35%), with 32% neutral and a total of only 12% either disagreeing (8%) or strongly

CFF Survey Y1 and Y2 Compared

Student Surveys (Q8f):

"I feel more confident about life after High School."

The patterns exhibited in Y1 and Y2 were different, With Y1 patterns indicating a shift toward neutral and Y2 indicating a shift toward the extremes. However, all shifts were small and neither pattern indicated movement in a particular direction, so it seems safe to say that CFF does not appear to be having influence on students' confidence about life after school.

Student Surveys (Q8g):

"I feel ready for the real world, with reference to my technology skills."

The majority of students (55%) feel confident in their technology skills and CFF seems to have increased this confidence slightly in Year Two.

Student Surveys (Q8h):

"The work I am doing in my classes will be useful to me in the job I hope to have as an adult."

Does CFF Influence Students' Interest in Teaching as a Career?

CFF Survey Year One

Student Surveys (Q8i):

"I have often thought about becoming a teacher."

A statistically significant change ($\chi^2 = 114.23$, $p < .001$) produced by shifts among response categories, indicates that on the post survey students were more likely to have thought about becoming a teacher. The direction of these shifts was very apparent, with moderate decreases in both "disagree" (3%) and "strongly disagree" (6%) and increases in the more positive categories ("neutral" up 3%, "agree" up 3% to 17%, and "strongly agree" up 2% to 13%).

Student Surveys (Q8j):

"I think teaching math or science would be fun."

A statistically significant change ($\chi^2 = 92.93$, $p < .001$) indicates that on the post survey students were more likely to think that it would be fun to teach math or science. The direction of these shifts was very apparent, with moderate decreases in both "disagree" (2%) and "strongly disagree" (6%) and increases in the more positive categories, with "neutral" up 4%, "agree" up 2% to 17%, and "strongly agree" up 2% to 10%).

CFF Survey Year Two

Student Surveys (Q8i):

"I have often thought about becoming a teacher."

A statistically significant change ($\chi^2 = 470.17$, $p < .001$), indicates that on the post survey students were more likely to have thought about becoming a teacher. The direction of these shifts was very apparent, with moderate decreases in both "disagree" (2%) and "strongly disagree" (3%) and increases in the more positive categories ("neutral" up 2%, "agree" up 1% to 17%, and "strongly agree" up 2% to 13%).

Student Surveys (Q8j):

"I think teaching math or science would be fun."

A statistically significant change ($\chi^2 = 337.22$, $p < .001$) indicates that on the post survey students were more likely to think that it would be fun to teach math or science. The direction of these shifts was very apparent, with small decreases in both "disagree" (2%) and "strongly disagree" (2%) and small increases in the more positive categories, with "neutral" up 2%, "agree" up 1% to 16%, and "strongly agree" up 1% to 10%).

CFF Survey Y1 and Y2

Compared

Student Surveys (Q8i):

"I have often thought about becoming a teacher."

Across both years, the survey results are remarkably consistent. Students were more likely to agree that they had thought often about becoming a teacher during the CFF post survey period, with 30% either agreeing (17%) or strongly agreeing (13%).

Student Surveys (Q8j):

"I think teaching math or science would be fun."

As with the question above, the results across Years One and Two are remarkably consistent, and positive. Students are more likely to agree that teaching math or science would be fun after their CFF experience. More than 1/4 of students either agree (16%) or strongly agree (10%) that being a science or math teacher would be fun, while about half do not.

Y2 Conclusions

The answer to the question, "Does CFF Influence Students' Interest in Teaching as a Career?" appears to be "Yes." On the CFF post survey students were more likely to say that they think often about becoming a teacher and that being a math or science teacher would be fun. However, it should be noted that about half of the students still do not think that being a math or science teacher would be fun, and that almost half (47%) do not think often about becoming a teacher.

Does Students Believe That They are Working Longer or Harder as a Result of CFF?

CFF Survey Year One

Student Surveys (Q8k):

"I feel challenged at this school."

A statistically significant change in response patterns ($\text{Chi}^2 = 11.44$, $p = .022$) characterized by very small shifts indicates a **slight change toward the neutral category** (2% increase), with very slight decreases in the "agree" category (1%) and the "disagree" category (2%).

Student Surveys (Q8l):

"I feel that if I work hard I can be successful in my classes."

A statistically significant change in response patterns ($\text{Chi}^2 = 102.57$, $p < .001$) indicates a primary change from both levels of agreement toward the neutral category (5% increase), with additional 1% increases in the "disagree" and "strongly disagree" categories. There were corresponding decreases in the "agree" category (2%) and the "strongly agree" category (4%). At the post survey period, **students were less likely to agree that if they worked hard they could be successful in their classes.**

CFF Survey Year Two

Student Surveys (Q8k):

"I feel challenged at this school."

A statistically significant change in response patterns ($\text{Chi}^2 = 185.61$, $p < .001$) characterized by small shifts indicates a **change toward the neutral category** (2% increase) and a slight increase in the "strongly disagree" category (1%), with a corresponding decrease of 3% in the "agree" category.

Student Surveys (Q8l):

"I feel that if I work hard I can be successful in my classes."

A statistically significant change in response patterns ($\text{Chi}^2 = 1041.44$, $p < .001$) indicates a significant decrease (5%) from strong agreement toward the neutral category (4% increase), with an additional 1% increase in the "strongly disagree" category. At the post survey period, **students were less likely to strongly agree that if they worked hard they could be successful in their classes.**

CFF Survey Y1 and Y2 Compared

Student Surveys (Q8k):

"I feel challenged at this school."

In both Years One and Two shifts toward neutral were noted. In Year One these were based on decreases in disagreement (2%) and agreement (1%), while in Y2 the shift was based on a shift from agreement only (3%). Still, these shifts are quite small, and the conclusion at this point might be that the CFF program does not appear to be having a major impact on students' perceptions of challenge at school.

Student Surveys (Q8l):

"I feel that if I work hard I can be successful in my classes."

In both Year One and Year Two, students were less likely to agree or strongly agree that they could be successful in their classes if they worked hard. However, it should be noted that during the pre survey period there are still many months during which effort can influence a student's grade, which may be the student's definition of success in class, while by the time the post survey is given the majority of scores that will comprise the student's grade have been recorded.

Student Surveys (Q8m):

"In my classes, time is spent answering questions from a book or worksheet."

A significant difference in pre/post response patterns ($\chi^2 = 11.53$, $p = .021$) revealed only very small shifts (all 1% or less) indicating, if anything, shifts toward strongly agreeing and strongly disagreeing (1% each). On the Y1 post survey, almost half of the CFF students (49%) either agreed (35%) or strongly agreed (14%) that time in their classes was spent answering questions from a book or worksheet.

Student Surveys (Q8n):

"The amount and rigor of class work my teacher assigns is pretty typical of other classes I have taken."

On the Y1 student post survey, roughly half (50%) of the CFF students agree that the rigor of work assigned by their teachers is typical, while only about 12% disagree. A statistically significant change in response patterns ($\chi^2 = 56.14$, $p < .001$) indicates stronger agreement, with an increase of 3% in the "strongly agree" category, and a decrease of 3% in the "agree" category. A 2% decrease in the "disagree" category and a

Student Surveys (Q8m):

"In my classes, time is spent answering questions from a book or worksheet."

A significant difference in pre/post response patterns ($\chi^2 = 131.79$, $p < .001$) revealed only small shifts (all 2% or less) indicating a slight shift toward disagreement. Two percent fewer students agreed that time in their classes was spent answering questions from a book or worksheet, and 1% more responded with "neutral" or "strongly disagree." On the Y1 post survey, almost half of the CFF students (48%) either agreed (34%) or strongly agreed (14%) that time in their classes was spent answering questions from a book or worksheet.

Student Surveys (Q8n):

"The amount and rigor of class work my teacher assigns is pretty typical of other classes I have taken."

On the Y2 student post survey, roughly half (48%) of the CFF students agree that the rigor of work assigned by their teachers is typical, while only about 14% disagree. A statistically significant change in response patterns from pre to post surveys ($\chi^2 =$

Student Surveys (Q8m):

"In my classes, time is spent answering questions from a book or worksheet."

There were very small changes in response patterns in both years, and in Y2 the pattern seemed to indicate a slight movement toward disagreement. However, it is still clear that almost half of the CFF students, despite the presence of the technologies and the professional development efforts, still spend time in their classes answering questions from a book or worksheet.

Student Surveys (Q8n):

"The amount and rigor of class work my teacher assigns is pretty typical of other classes I have taken."

The pre/post differences were very small and difficult to interpret, but the important take away message from this item seems to be that CFF students tend to find the amount and rigor of the work their teachers assign typical of that they see in other classes.

CFF Survey Year One

Student Surveys (Q8k):

"I feel challenged at this school."

A statistically significant change in response patterns ($\chi^2 = 11.44$, $p = .022$) characterized by very small shifts indicates a **slight change toward the neutral category** (2% increase), with very slight decreases in the "agree" category (1%) and the "disagree" category (2%).

Student Surveys (Q8l):

"I feel that if I work hard I can be successful in my classes."

A statistically significant change in response patterns ($\chi^2 = 102.57$, $p < .001$) indicates a primary change from both levels of agreement toward the neutral category (5% increase), with additional 1% increases in the "disagree" and "strongly disagree" categories. There were corresponding decreases in the "agree" category (2%) and the "strongly agree" category (4%). At the post survey

CFF Survey Year Two

Student Surveys (Q8k):

"I feel challenged at this school."

A statistically significant change in response patterns ($\chi^2 = 185.61$, $p < .001$) characterized by small shifts indicates a **change toward the neutral category** (2% increase) and a slight increase in the "strongly disagree" category (1%), with a corresponding decrease of 3% in the "agree" category.

Student Surveys (Q8l):

"I feel that if I work hard I can be successful in my classes."

A statistically significant change in response patterns ($\chi^2 = 1041.44$, $p < .001$) indicates a significant decrease (5%) from strong agreement toward the neutral category (4% increase), with an additional 1% increase in the "strongly disagree" category. At the post survey period, **students were less likely to strongly agree that if they worked hard they could be successful in their**

CFF Survey Y1 and Y2 Compared

Student Surveys (Q8k):

"I feel challenged at this school."

In both Years One and Two shifts toward neutral were noted. In Year One these were based on decreases in disagreement (2%) and agreement (1%), while in Y2 the shift was based on a shift from agreement only (3%). Still, these shifts are quite small, and the conclusion at this point might be that the CFF program does not appear to be having a major impact on students' perceptions of challenge at school.

Student Surveys (Q8l):

"I feel that if I work hard I can be successful in my classes."

In both Year One and Year Two, students were less likely to agree or strongly agree that they could be successful in their classes if they worked hard. However, it should be noted that during the pre survey period there are still many months during which effort can influence a student's grade, which may be the student's definition of success in class, while by the time

Section Six: Factors that May Be Enhancing or Limiting Program Impact

This section considers mediating factors, based on two broad questions about what might be limiting CFF's potential impact:













- What technology-related problems might be limiting the program's impact?
- What people or system problems might be limiting the program's impact?

What Technology-related Problems are Experienced that Might be Limiting the Programs Impact— Hardware Failures?

CFF Survey Year One and Two

Teacher Survey (Q17-A-1 through 17-A12)

(See Appendix C, Tables Q17-A-1 to Q17-A-12 for details.)

Year One CFF Teacher Perceptions of the Magnitude of Various Implementation Issues	Year One Problem Total	Year Two Problem Total	Year One Problem Rank	Year Two Problem Rank
 Inadequate Professional Development	36%	39%	1	2
 Computer Failures	35%	41%	2	1
 Network Downtime	33%	39%	3	2
 Printing Problems	27%	31%	4	4
 Plagiarism	22%	22%	5	6
 Lack of Technical Support	20%	22%	6	6
 Electronic White Board Problems	19%	25%	7	5
 Battery Issues	15%	21%	8	8
 Projector Problems	13%	13%	9	10
 Sound Problems	12%	14%	10	9
 Theft	8%	4%	11	12
 Vandalism	8%	5%	11	11

CFF Survey Y1 and Y2 Compared

Teachers were asked to rate each of the anticipated problems in the table at the left according to the level of problem they experienced, choosing from "no problem," "small problem," "problem," "significant problem," or "huge problem." (See Appendix C, Tables Q17-A-1 to 17-A-12 for details.)

To determine the overall magnitude of the problems, we added the percentages of teachers who rated each problem as a "problem," "significant problem," or "huge problem," and then ranked the highest total "1" to indicate the top priority, and proceeded to rank the other problems in order by totals. Ranks were shared to indicate two problems receiving the same totals, and the next rank was omitted.

As illustrated in the table to the left, the ratings were relatively consistent.

"Computer problems" edged out "insufficient professional development" and "network downtime" to be identified as the #1 problem in CFF classrooms.

CFF Interviews

The technology directors provided insight on the technology-related problems that limited the programs impact. One of the issues identified was the nature of the school's infrastructure. As one director noted, the problem was "Trying to stick 21st century technology into 19th century classrooms." He further stated that, "We have the enthusiasm on our students' part, we have the enthusiasm on our teachers' part. Unfortunately, those classrooms were built at a time when nobody even had to imagine what we would need to put in there. Particularly, the smartboard technology with the projectors, trying to figure out where to put them without having any hazards. I don't think the barrier any more is the enthusiasm of teachers to grasp this; obviously the kids are going to grasp technology. It's trying to squeeze that stuff into buildings that were not constructed to handle that."

Other findings from the interview data relate to wireless and network issues (23%), problems with Lenovo computers' configuration—slow startup, re-imaging, memory (26%), and a few issues with file serving student data, switching from Apple to PC (6%) and internet security (6%). Nearly 39% of the technology directors, however, reported that they did not have any technology issues other than those described under implementation issues.

Conclusions

The top three problems faced by teachers in CFF classrooms are "computer problems," "insufficient professional development," and "network downtime, with "printing problems" a relatively close third. Battery issues and projector problems were surprisingly low on the list, and theft and vandalism were at the bottom.

What People or System related Problems might be limiting the Programs Impact—Tech Support?

CFF Survey Year One

Student Survey (Q10):

Sixty-three percent of students reported that computers get repaired in one day or less, and 20% reported computer repairs in an hour or less. About 24% of students report that network issues are resolved within an hour, and 46% report that they can get help on a software problem or issue within an hour.

Computer repair response time improved significantly between the pre and post survey periods ($\chi^2 = 58.14$, $p < .001$).

CFF Survey Year Two

Student Survey (Q10):

Reports in Year Two were very similar to those in Year One, with 61% of students reporting that computers get repaired in one day or less, and 20% reporting computer repairs in an hour or less. About 26% of students report that network issues are resolved within an hour, and 49% report that they can get help on a software problem or issue within an hour.

Computer repair response time improved significantly between the pre and post survey periods ($\chi^2 = 628.37$, $p < .001$), as did the time required to solve network problems ($\chi^2 = 461.27$, $p < .001$).

CFF Survey Y1 and Y2 Compared

Very similar results across Years One and Two indicate a good level of service in CFF schools.

PATI Survey (Q33-A-9):

A comparison of CFF teacher responses and non-CFF teacher responses to PATI survey items showed that technical support is perceived by CFF teachers to be better than support received in non-CFF schools in terms of access to technical support with little or no wait time at school ($\chi^2 = 143.27$, $p < .001$) and in terms of instructional support that helps teachers integrate technology ($\chi^2 = 415.20$, $p < .001$).

CFF Interview Results

In any implementation requiring technology, there are always concerns about technology support. The technology directors (33%) consistently reported that they needed more support personnel. When asked about the most challenging aspect of the CFF program, 24% of technology directors cited the district infrastructure, 15% cited making the equipment work, and 15% cited timeline and implementation issues--all factors that impact the technology support available for the program.

One of the issues was the need to re-image the laptops, which caused a strain on their technicians. One technology director talked about his experience, stating, "It isn't just CFF, it's technology period. It has always been a struggle, especially in our district where it has been hardware rich for a long time is that hardware needs to be serviced. In a business world where you have one tech per 75 computers, and I have one tech for every thousand computers. It doesn't take a mathematician to figure out trying to keep up with that."

Y2 Conclusions

Support services in CFF schools are, in most cases, good and getting better. Computer problems, network problems, and software problems seem to get handled quickly, with significantly improved response times indicated between pre and post surveys. Technology support is better in CFF schools than it is in other high schools.

In both years, more than 60% of students reported that computers get repaired in one day or less, with 20% reporting repairs in an hour or less. About 25% of students report that network issues are resolved within an hour, and roughly half report that they can get help on a software problem or issue within an hour.

Section Seven:

A Preliminary Look at 21st Century Skill Development

This report describes a preliminary research study that investigated potential differences in the development of 21st Century Skills with students from Classrooms for the Future schools where the majority of the student population has one-to-one access to educational technology, as compared to comparable control schools where a more typical level of computer access was provided. The research investigated the development of creativity, internet-based research skills, group problem solving, teamwork, presentation skills, and formal reasoning skills at the high school level.

Overview

Myers and Dynarski (2003, p. 1) proposed that evaluation of educational programs serves two primary functions: 1) to test whether education programs help the students they are designed to serve, and 2) to explore whether new ideas for education programs still under development are worthy. In education, "worthiness" is difficult to measure, and is often defined by easy-to-measure factors such as the program's impact on student achievement on standardized tests of content knowledge.

While important, these studies often miss the real goals of the innovation. Few studies examine the effects of an innovation on crucial "21st century skills," such as creativity, formal reasoning, collaboration during group problem solving tasks, independent Internet research, and performance-based problem solving tasks. This study attempts, despite several constraints common in school-based research, to do just that, examining potential effects of the increased access to technology in the Classrooms for the Future program on the development of 21st century skills.

The ideal research design to investigate whether students in schools providing one-to-one computer access develop differently than students in schools without that access would involve randomly assigning both teachers and students to two conditions -- one with one-to-one access and the other without. In general, 'random assignment' in studies of a particular program's impact refers to forming "two statistically equivalent groups of participants in the most objective way possible" (Myers & Dynarski, 2003, p. 2), a process that schools often find troubling because they do not want to deprive students of a treatment they perceive as beneficial. The ideal research design would also allow time for the implementation to stabilize and time for the stable practices to have an effect on students before assessing differences between the two populations.

Since random assignment is not possible in this study, and the time required to cultivate the treatment has already been invested by the Commonwealth of Pennsylvania, we chose schools similar with respect to the most important characteristics and recruited students in an identical manner in each location, to produce similar sets of participants in both the CFF schools and non CFF schools under study. The performance of these two groups during the day of data collection by students forms the basis for our analysis.

Research Questions

The following set of research questions, developed in close consultation with the Pennsylvania Department of Education, outline the scope of the "research framework" (Zucker, 2004) used in this study. These research questions were:

1. Do CFF students whose education has involved greater access to technology (one-to-one access to computers at the high school level) outperform students in the control condition (students from high schools determined to be demographically similar to the school, but with a more typical level of technology access) on a

- research project that involves using online resources, requires higher-order thinking, and requires delivering the presentation using presentation software (i.e., PowerPoint or Keynote)?
- a. Do the two groups produce presentations of different levels of quality?
 - b. Do the two groups exhibit different levels of oral presentation skill?
 - c. Do the two groups learn more or less about the topic on which the presentation was based?
2. Do students in the treatment condition perform differently on a collaboration task (Group Problem Solving) than students in a control condition?
 3. Do students in the treatment condition perform differently than students in the control condition on the *Torrance Tests of Creativity* (Figural Form)?
 - a. In Fluency?
 - b. In Originality?
 - c. In Elaboration?
 - d. In Resistance to Premature Closure?
 - e. In Abstractness of Titles?
 - f. In the Overall Creativity Index?
 4. Do students in the treatment condition perform differently on the *Arlin Test of Formal Reasoning*, which assesses development using Piaget's formal schemata of intellectual development, which monitors students' understanding of compensations, correlations, probability, combinations, proportions, forms of conservation beyond verifications, and mechanical equilibrium?

Background

21st Century Skills

How do we measure 21st century learning? This process involves not only the student's acquisition of such knowledge, but also the application of this knowledge through its' expression in a comprehensive skill set. The "Framework for 21st Century Learning" (*Partnership for 21st Century Skills*, 2007) aims to 'plan backwards' from the stated 21st century student outcomes to the aptitudes and skills required to obtain these outcomes.

Twenty-first century learning contains two components: 21st century knowledge and 21st century skills. Knowledge is gained through the mastery of core subjects (reading, math, science, and social studies) and the overlooked 21st century content, which includes global awareness, financial, economic, business, and entrepreneurial literacy, civic literacy, and health literacy.

The *Partnership for 21st Century Skills* (2005, p. 10) emphasizes that the key principles of the assessment of 21st century learning involves the development of assessment tools that measure student mastery, diagnose where students require intervention, measure the educational system's effectiveness, and provide the opportunity for students to

demonstrate these skills. While recognizing that no single assessment tool is sufficient to measure these objectives, this study focuses on all these objectives in a systematic fashion.

Learning skills are the focus of this study. These skills are described by the *Partnership for 21st Century Skills* (2005, pp 15-16) in the following way:

- *Critical thinking and systems thinking.* Exercising sound reasoning in understanding and making complex choices, understanding the interconnection among systems.
- *Problem identification, formulation, and solution.* Ability to frame, analyze, and solve problems.
- *Creativity and intellectual curiosity.* Developing, implementing and communicating new ideas to others, staying open and responsive to new and diverse perspectives.
- *Interpersonal and collaborative skills.* Demonstrating teamwork and leadership; adapting to varied roles and responsibilities; working productively with others; exercising empathy; respecting diverse perspectives.
- *Self-direction.* Monitoring one's own understandings and learning needs, locating appropriate resources, transferring learning from one domain to another.
- *Accountability and adaptability.* Exercising personal responsibility and flexibility in personal, workplace, and community contexts; setting and meeting high standards and goals for one's self and others; tolerating ambiguity.
- *Social Responsibility.* Acting responsibly with the interests of the larger community in mind; demonstrating ethical behavior in personal, workplace and community contexts.

Investigating such crucial areas as critical thinking, problem solving, creativity, and collaborative skills, our study focuses on a variety of measures and assessment tools to measure a student's demonstration of formal reasoning, creativity, problem solving, performance-based tasks, and collaboration. In this study, technology is infused within each component of the analysis, especially with the performance-based task that involves the student's systematic investigation of a given theme using Internet resources.

Another way of looking at the skills that will be needed in the future is provided by Lemke et al. (2003). This model consists of four parts that overlap with the *Partnership's* framework. These areas are digital age literacy, inventive thinking, effective communication, and high productivity. Our study uses various instruments (described below) to measure 21st century skills and touches on all four areas.

In particular, productivity is gauged through the *performance evaluation task* and *group problem-solving task*. In the *performance evaluation task*, control students are instructed to investigate a topic using the Internet, to organize their findings, and to create effective presentations during the same time period and under the same conditions as the Classrooms for the Future students. These two tasks target elements of high productivity,

including the capacities to prioritize, plan, and manage activities, effectively use real world tools, and produce relevant, high-quality products.

Treatment and Control School Districts

Tasked by the Commonwealth of Pennsylvania to plan, execute, and analyze this research, the Classrooms for the Future Evaluation Team focused closely from the outset on choosing representative treatment schools and those control schools that were highly similar to the CFF schools based on common indicators prior to the implementation of CFF (the 2005-06 school year). The Classrooms for the Future program is a statewide initiative whose scope has been determined by the implementation of the program in successive stages. Implementing a program designed to provide intensive access to educational technology within three cohorts of schools, Cohort 1 (06-07), Cohort 2 (07-08), and Cohort 3 (08-09), the Classrooms for the Future program is supported by professional development and coaching opportunities designed to hone the use of this technology among students and teachers.

By purposely sampling CFF schools from Cohort 1, the schools with the longest period of exposure to the treatment condition (high levels of access to educational technology and to professional development opportunities), this research design chose three CFF schools that best represented the implementation of the program at the school level in the eyes of both the Evaluation Team, the Pennsylvania Department of Education, and available indicators of implementation of the program.

Finding a control school raised a few challenges. First, the control school couldn't be a CFF school due to the demonstrated influence this program has on technology access and usage (Peck et al., 2007). An ideal control condition would be a typical level of technology integration, such as might be expected if the district had not adopted Classrooms for the Future's goals and agenda. This choice was based on three sequential research steps:

1. Find those schools most similar to the purposely-sampled CFF schools on the basis of socio-economic data. This analysis first would identify 10 schools most proximate to each CFF school based on the socio-economic data. This lead to three sets of socio-economic data, one grouping for each CFF School.
2. For each of these datasets, find that school most similar to each CFF School on the basis of academic achievement data from the 2005-06 academic year.
3. Contact both the purposely-sampled CFF schools and their control schools and arrange for the on-site research activities.

In doing so, we were successful in securing the participation of each CFF and control school. Unfortunately one of our CFF schools had to remove themselves from the study prior to the on-site research (Treatment School C) due to the lack of available students at the end of the school year. Yet as seen below, two of the CFF schools were already highly similar (indeed controls for each other) based on both the socio-economic and academic achievement data. We boosted the student participation at the remaining CFF

schools to account for this variation, but kept the same number of participants from the control schools.

We sought to identify schools with similar demographics to each of the three CFF schools, similar communities with roughly similar numbers of people in different demographic groups. Using guidance provided by the Pennsylvania Department of Education, we chose to use the "SAIPE Index" to identify similar districts by determining the percentage of the district's children living in poverty. (See Tables 1 through 4 below.) This "Small Area Income Poverty Estimate" (a mid decennial income estimate) is conducted annually, and estimates are created for states, counties, and school districts.

The main objective of this program is to provide updated estimates of income and poverty statistics for the administration of federal programs and the allocation of federal funds to local jurisdictions. Beginning with the estimates for 2005, data from the American Community Survey are used in the estimation procedure, while all prior year estimates used data from the Annual Social and Economic Supplements of the Current Population Survey (U.S. Census Bureau, 2008). What makes this poverty estimate invaluable is that it provides the most recent data available (e.g. the last census data dates from 2000) and furthermore the estimate is broken down by school districts nationally. The 2005 dataset, the most current dataset available, was used to create the list of schools in Tables 1 through 4 below, creating three groupings of schools clustered around each of the chosen CFF schools.

Table 1: SAIPE Index—CFF and Treatment Districts “Grouping A”

	Estimated Total Population	Estimated Population 5-17	Percent of children in poverty
FRANKLIN AREA SCHOOL DISTRICT	16758	2906	16.79%
KANE AREA SCHOOL DISTRICT	7843	1267	16.81%
CRANBERRY AREA SCHOOL DISTRICT	9429	1565	16.87%
REDBANK VALLEY SCHOOL DISTRICT	8566	1452	16.87%
CONTROL SCHOOL DISTRICT A	30572	4468	16.94%
TREATMENT SCHOOL DISTRICT A	21358	3453	17.00%
TAMAQUA AREA SCHOOL DISTRICT	15927	2394	17.00%
FRAZIER SCHOOL DISTRICT	8391	1234	17.26%
FOREST AREA SCHOOL DISTRICT	7085	996	17.47%
VALLEY GROVE SCHOOL DISTRICT	6762	1071	17.55%
POTTSVILLE AREA SCHOOL DISTRICT	20915	3210	17.57%

(Small Areas Poverty Estimate, 2008)

Table 2: SAIPE Index—CFF and Control School “Groupings B and C”

	Estimated Total Population	Estimated Population 5-17	Percent of children in poverty
BETHEL PARK SCHOOL DISTRICT	32675	5813	4.15%
SPRING GROVE AREA SCHOOL DISTRICT	26090	4718	4.18%
SPRING-FORD AREA SCHOOL DISTRICT	37928	6624	4.27%
TREATMENT DISTRICT B	16272	3650	4.38%
TREATMENT DISTRICT C	4632	816	4.41%
PENNRIDGE SCHOOL DISTRICT	44395	8391	4.68%
PHOENIXVILLE AREA SCHOOL DISTRICT	30695	4880	4.69%
CONTROL DISTRICT B	15997	2616	4.89%
CONTROL DISTRICT C	25850	4076	4.93%

(Small Area Income Poverty Estimate, 2008)

Based on these Groupings, our research design also included an analysis of scores on the PSSA examination in 2005-06 (the year before the implementation of the Classrooms for the Future Program). By focusing on the similar percentages of Advanced and Proficient students as the basis of comparison, our team narrowed the list of potential control schools to the three selected.

Table 3: Selected Schools’ 2005-06 PSSA Scores Compared

	Math					Reading				
	Adv	Prof	Basic	Below	Adv + Prof	Adv	Prof	Basic	Below	Adv + Prof
Treatment School A	22.3	38.8	19.2	19.6	61.1	32.1	39.3	13.4	15.2	71.4
Forest Area	6.3	34.9	27.0	31.7	41.2	22.2	46.0	11.1	20.6	68.2
Redbank Valley	19.3	38.6	28.4	13.6	57.9	33.0	45.5	14.8	6.8	78.5
Franklin Area	17.5	32.7	22.8	26.9	50.2	28.1	44.4	12.3	15.2	56.7
Cranberry	27.8	28.9	21.6	21.6	56.7	37.1	34.0	11.3	17.5	45.3
Valley Grove	14.7	32.0	29.3	24.0	46.7	16.0	42.7	22.7	18.7	58.7
Kane Area	19.6	37.4	15.9	27.1	57.0	26.2	39.3	22.4	12.1	65.5
Control District A	24.0	33.5	18.8	23.6	57.5	38.3	38.3	11.2	12.1	76.6
Glendale	13.3	32.0	26.7	28.0	45.3	21.3	36.0	20.0	22.7	57.3

Table 4: Selected Schools' 2005-06 PSSA Scores Compared

	Math					Reading				
	Adv	Prof	Basic	Below	Adv + Prof	Adv	Prof	Basic	Below	Adv + Prof
Treatment District B	49.8	33.4	8.4	8.4	83.2	47.8	34.2	12.1	5.9	82.0
Bethel Park	34.5	37.1	15.9	12.5	71.6	41.2	41.6	8.5	8.7	82.8
Treatment District C	17.5	40.0	27.5	15.0	57.5	37.5	40.0	12.5	10.0	77.5
Spring-Ford Area	31.7	29.9	17.0	21.5	61.6	33.0	38.9	17.6	10.4	71.9
Control District B	25.2	30.4	20.1	24.3	55.6	36.4	44.9	11.2	7.5	81.3
Penn Ridge	32.0	33.8	17.5	16.7	65.8	34.8	42.6	11.2	11.4	77.4
Phoenixville Area	32.5	30.6	20.0	16.9	63.1	45.3	35.4	8.7	10.6	80.7
Control District C	31.0	36.5	20.3	12.2	67.5	35.5	43.1	13.7	7.6	78.6

Through networking via email and telephone conversations, we quickly determined that both the identified CFF schools and the control districts (the names of which are not provided for purposes of anonymity) consented to participate. As indicated in Table 1 above, the CFF schools and corresponding control school in Grouping A have a highly similar percentage of children who live in poverty (different by only about .06 of a percent). Further, these schools are highly similar on the basis of available academic achievement data, differing by only 5% in terms of students who scored advanced or proficient on the PSSA in both subject areas before the CFF program was implemented.

As indicated in Table 3, both Groupings B and C are highly similar, indeed controls for each other. The range within these two groupings on the SAIPE index is less than two-thirds of a percent. Further, the range on the basis of academic achievement is similar, differing by 4.5 percentage points.

In Table 5 below, we present a comparison of the Treatment and Control school districts based on commonly accepted indicators from the Common Core of Data (NCES, 2008) and the Pennsylvania Department of Education (PDE, 2008).

Table 5: Treatment and Control Conditions Compared

Selected School District Data (2005-06)						
	Treatment A	Control	Treatment B	Control	Treatment C	Control
Total Schools	9	9	5	5	3	4
Total Students	2661	4170	4224	2074	584	3148
Total Classroom Teachers	192	309	283	142	48.3	192
Student-Teacher Ratio	13.9	13.5	14.9	14.6	12.1	16.4
Students with IEPs	493	713	447	379	87	357
Total Revenue	\$33,304,000	\$47,746,000	\$46,825,000	\$29,639,000	\$10,463,000	\$39,264,000
Amount per Student	\$12,276	\$11,469	\$11,587	\$14,229	\$17,978	\$12,649

Taking into account that the Treatment C school was unable to participate (the outlier of the focus schools), these sets of treatment and control schools are remarkably similar in size, number of students, student-teacher ratio, and amount spent per student on education.

Methodology

The rigor of a study is determined both by the design of the study and the procedures through which the data are collected, managed, analyzed, interpreted, and discussed. In this section, we describe our approach, discussing the primary research steps involved: data collection, data management, and data analysis. The data collection in this study, from the perspective of an individual participant, consists of a day of activities run specifically for purposes of this analysis at either the control or treatment site.

Data Collection

This section discusses participant samples used during this study, including the procedures used for recruiting and selecting students, the percentages of students at each grade level for either the treatment or control conditions, and the gender composition of this population. Second, this section addresses the protocols used for collecting the data, describing the tasks and outlining our research protocol for each task.

Subjects

Recruitment was handled in a similar manner within the two school districts. Teachers were asked to distribute letters explaining the study, as well as parent consent forms to all students in the specified grade levels (9-12). The letter informed students and their parents that the study would be conducted on a Saturday at a district school, and that students who participated would receive compensation (\$80) for the eight-hour day of activities. When more than 40 students had volunteered at a given school level, participants were randomly selected from among the volunteers.

The Treatment subjects in the study include 61 students representing roughly 30 at each participating school. Data collection took place on two different Saturdays in May of 2008, at the two high schools.

Subjects in the control condition (71) represented the same grade levels as the treatment condition. Students were recruited for the day of activities, randomly selected from the recruitment population, and then offered the same compensation for their time as in the treatment condition. The events took place in three schools across the state, on a single Saturday in May of 2008.

Similarities and differences can be seen in the overall composition of the treatment and control populations. As seen in Table 6 below, the gender composition is remarkably proportionate across the two districts.

Table 6: Description of Sample

	Treatment	Control	Proportion Treatment
Total	61	71	.94
Male	34	30	1.13
Female	27	41	.69

A noteworthy difference is the make-up of the grade cohorts. When analyzing the proportions of treatment students and the gender make up of that cohort in comparison to the control condition, there were many more young males in the treatment condition than proportionally in the control condition.

The Tasks

The day of data collection activities proceeded in the same fashion in both treatment and control conditions. The day started off with a brief explanation of the study. Next, the students took the *Torrance Tests of Creativity* (Figural Form), and were then introduced to an ill-structured task involving online research and the development of a presentation.

Students were told to prepare a presentation for parents of children that had just been identified as autistic. After two hours working on the presentation, they broke for lunch and a group problem-solving task (in groups of four or five students) involved the creation of a tower using toothpicks and clay that cantilevered, horizontally, over a line to the greatest extent possible, a collaboration-based task that lasts 10 minutes. The group interactions during the problem-solving task were videotaped, and blind reviewers using a rubric designed to capture problem-solving skill processes, teamwork, and leadership skills scored the recordings.

After lunch students had another 30 minutes (in addition to the two hours before lunch) to complete the development of their presentations and to save them to a server (or to flash

drives in conditions in which there was no access to a shared server) where they were collected by the research team. Students then rotated through three stations where they: 1) delivered the presentations they had developed in front of one adult and a video camera, 2) took a content test on the content they had researched in preparing the presentation, and 3) took the *Arlin Test of Formal Reasoning*.

Videos of the presentations were also scored by blind reviewers, who had a copy of the presentation files and who used rubrics designed to document the quality of the content and the delivery of the presentation. These rubrics are found in Appendix H.

The Torrance Tests of Creative Thinking

The Torrance Tests of Creative Thinking are among the most commonly used tests in the gifted education field. The test is valid for various grade levels, including the high school aged students involved in this study. The test focuses on different drawing tasks that together, throughout the booklet, are supposed to reflect a story that is told both through pictures and the titles they bear. The test invites learners to reflect on their life and tell that story. The title itself can be a statement, question, comment, etc. Each title and drawing builds upon the previous drawing, together forming the story in a cumulative fashion. Widely used for identification of creatively gifted students, these tests have been taken by populations around the world. Since this is a well-established test, national and even international, multicultural, and special needs populations have norms that benchmark the analysis. The scoring of the Torrance Exams for purposes of this study was provided by the Scholastic Testing Service, the developer and distributor of the examinations. (More on the Torrance Test is presented in the data analysis subsection.)

Individual Ill-Structured Presentation Task

The presentation task involved online research and the development of a presentation on autism. Students were told to prepare a presentation for parents of children that had just been identified as autistic.

The task was presented to the students in writing (See Appendix H: Exhibit B) and was, by design, "**ill-defined**." In other words, many of the questions were left unanswered for students to determine on their own. The purpose of the assignment was clear (informing uninformed parents of an autistic child about the disease but they were not advised to define terms, describe symptoms, to discuss the most effective treatments, etc., or to end with an uplifting message (a structure that teachers might normally have provided for students). This was done purposefully, to assess the extent to which the students can develop their own effective organization for the message.

Students were restricted to the use of online resources in order to eliminate the possibility that the school's library or the students' personal access to books would affect the quality of their work. Student work took place in a school computer lab, with an Internet-connected computer for each student. Each computer had electronic presentation

software (PowerPoint and/or Keynote), Microsoft Office (Word, Excel, and Explorer), video and audio processing capabilities (iMovie or equivalent), and one or more Internet browsers (i.e., Explorer, Safari, Mozilla, Firefox,).

After the videos and presentation documents were collected and copied to DVD format (for purposes of data management), each individual presentation was scored by two reviewers who used a rubric (see Appendix H, Exhibit C) containing a set of criteria designed to document the quality of the content and the delivery of the presentation, as well as identifying evidence of students' 21st century skills. This team consisted of blind reviewers, since all identifiers were stripped from the videos and the presentations (e.g. Powerpoint or Keynote) and a number was assigned to each video clip for tracking purposes.

The rubric development team was also charged with doing a pilot test of the rubric on 10 randomly selected presentations. This rubric development team, which was distinct from the larger presentation evaluation team, executed research on established rubrics, adapted these models, and aligned the contents of this rubric for the specific purposes of this study. This whole presentation evaluation team met prior to the scoring process to review the rubric and establish inter-rater reliability for the analysis group.

The rubric was further reviewed and revised during the inter-rater reliability meetings for purposes of consistency of the group analysis. The final version of the Presentation Task Rubric is found in Appendix H, Exhibit C. Each clip (n=132) was reviewed by two evaluators, who first entered quantitative scores using the rubric, and then expanded on the particular quantitative score by writing narrative comments pertaining to unusual cases. The ten quantifiable measures in the rubric that are substantively analyzed in the Ill Structured Presentation Task are listed in Table 7 below.

Table 7: Ill Structured Presentation Task Variables

Variable	Definition of Variable	Range of Value (1 -4)
Content Coverage	To what degree student covered content defined by the researchers as key to the topic.	1-4
Quality of the Content	Measure of the accuracy of the content presented by the student.	1-4
Relationship of Visual and Spoken Content	How well student was able to expand verbally on the content in their presentation.	1-4
Presentation Organization	Whether organization is presented in a logical, interesting sequence that the audience can easily follow.	1-4
Maintains Eye Contact	Degree to which student maintains eye contact with the audience.	1-4
Body Language	Degree to which students incorporate appropriate body language while presenting.	1-4
Voice	The degree to which the presenter showed poise or nervousness while presenting	1-4
Use of Sources	To what extent student cited her sources in the presentation.	1-4
Use of Images	Degree to which the images in the presentation contributed to explain or reinforce the content.	1-4
Artistic Images	How effectively student used fonts, color, slide design, and formatting to enhance the presentation.	1-4
Mechanics	The extent to which the presentation was free of spelling and grammatical errors.	1-4

The Group Problem Solving Task

The students were tasked with an activity that involved the creation of a tower using toothpicks and clay with the goal of cantilevering it, horizontally, over a line to the greatest extent possible within a 10-minute timeframe. The group problem-solving task was designed to elicit teamwork and creativity in a group setting.

The problem for this study was adapted from the *Odyssey of the Mind* program based on the "Cantilever Structure" problem, in *Make Learning Fun!: Activities to Develop Creativity*, by Dr. C. Samuel Micklus. Each student was given a written set of instructions relating to the task (see Appendix H). During the task, proctors monitored the students' work. The group problem-solving task was videotaped for later analysis using a scoring rubric that assessed teamwork, leadership, and negative behaviors.

Arlin Test of Formal Reasoning (ATFR)

The ATFR is based upon Piagetian principles. Eight sub-tests measure applications of Piaget's principles: volume, probability, correlation, combinations, proportions, momentum, mechanical equilibrium, and frames of reference. Since the 1980's, numerous studies have researched the validity of the instrument and many have incorporated the method in research designs. The ATFR was designed, essentially, as a group test to measure the intellectual and cognitive level of the student - concrete, high concrete, transitional, low formal, or high formal. Pupils at the concrete or high concrete level would be in Piaget's concrete operational stage, while pupils in the transitional stage would exhibit some instances of formal reasoning. In Table 8 below, we present the different levels based on these Piagetian principles:

On this 32-item measurement of formal reasoning, students score in a range of levels. The readability of the survey is gauged at the 6th grade reading level, with item-by-item readability at lower grade levels. Nonetheless, it proves challenging and appropriate for the upper grades. It is important to note that the items are represented in non-scientific, non-mathematic ways, so that participants are able to infer these kinds of concepts from the questions without necessarily having to know the scientific or mathematical principles. These items have been normed in multiple studies. The majority of the participants in the population have been white, middle class students. Of note, efforts are underway to make the test relevant to other ethnicities and socio-economic levels.

Table 8: Arlin Categories

Operational Level	Description	Total Score
Concrete	Provides no evidence of abstract reasoning and some difficulty with reasoning skills that are problem specific.	0-7 points
High Concrete	Provides some evidence of a systematic approach to problems but not evidence of forming a general rule or abstraction from the problems. This level indicates some ability to classify and organize information but provides little evidence of the ability to make inferences	8-14 points
Transitional	Provides evidence of a systematic approach to the problems, and some use of abstractions and inferences but performance is quite inconsistent.	15-17 points
Low Formal	Gives clear evidence of 3-5 of the formal schemes being present in their thinking. They are capable of abstraction and of making inferences but need to be provided opportunities to develop thinking skills with respect to the other formal schemes.	18-24 points
High Formal	Clear evidence of most of the formal schemes being in evidence in their thinking.	25-32 points

(Slosson Educational Publications, 1984)

Data Management

None of the data used by the data analysts in this study contains information that connected students with their products. Team members placed their products in a password-protected secure folder put onto their computer for data analysis purposes. Videos and other forms of data were sent via UPS on 160 GB Hard Drive labeled with code numbers for analysts who were unable to come to State College to retrieve the data. The analysts were instructed not to make copies of the contents of the hard drives and were required to return the hard drives with their evaluations. All primary data is being kept on a secure (password protected with networking disabled) laptop computer (with a back up on a secure external hard drive).

The process of making the DVDs was complex and merits attention. First, the data management coordinator transferred the video onto a laptop (with networking disabled). Next, the video was compressed and formatted so that it could be made into digital "clips" representing each performance. ID numbers were matched to individual performance task videos and all identifiers were edited out. Sets of clips for each task, presentation and group problem solving) were sent to analysts. Two analysts received each sets of clips to view and rate.

The process of compiling the performance task and test data sets was also complex. The analysts entered the performance task data into an Excel database that compiled the data. The data management coordinator sorted the data into different sets representing Treatment grade cohorts and control grade cohorts. Files were then prepared to load into SPSS (Statistical Package for the Social Sciences) for analysis.

The *test* data sets were analyzed in one of two ways. The Scholastic Testing Service graded the Torrance Tests of Creativity exam and output was provided by that organization. The content test was scored with the use of an answer key by our team. Likewise, the Arlin exam was rated with use of the Arlin Test Manual by our team. All five data sets were provided to our quantitative analyst who analyzed the variables in appropriate ways, as detailed in the Results section below.

Results

Oral Presentation Task

The presentation task analyses sought to identify whether Treatment students, from a technology rich learning environment, outperformed their peers on identical ill-structured tasks when provided with the same set of instructions, time-limits, access to technology, and limited facilitation. The four research questions that the presentation task analysis sought to resolve are:

Do students in the treatment condition, whose high school education has, for the last year and a half, involved increased access to computers add lessons from teachers who had participated in the CFF professional development, outperform students in the control condition (students from high schools determined to be demographically similar, but in which one-to-one access is not provided) on a research project that involves using online resources to answer a question or to develop a response that requires higher-order thinking and presenting that answer in the form of an oral response using presentation software (i.e., PowerPoint or Keynote)? Specifically...

1. Do the two groups produce presentations of different levels of quality?
2. Do the two groups exhibit different levels of oral presentation skill?
3. Do the two groups learn more or less about the topic on which the presentation was based?

In response to these research questions, we present the results of the descriptive and T-test analyses comparing treatment and control conditions.

Table 9: Presentation Task Analyses

	Mean			Standard Deviation		T-Test	
	Treatment	Control	Difference	Treatment	Control	t value	p value
Content Coverage	3.92	3.94	-0.02	0.515	0.542	1.38	0.17
Quality of the Content	2.20	1.96	0.24	1.232	1.298	1.087	0.279
Relationship of Visual to Spoken Content	2.10	1.90	0.20	0.877	0.866	1.315	0.191
Presentation Organization	3.22	3.28	-0.06	0.613	0.643	-0.563	0.574
Maintains Eye Contact	2.63	2.38	0.25	0.863	0.811	1.696	0.092
Body Language	2.25	1.97	0.28	0.751	0.791	2.042	0.043
Voice	3.12	2.96	0.16	0.691	0.633	1.373	0.172
Use of Sources	2.05	1.29	0.76	2.354	1.932	1.994	0.048
Use of Images	2.03	1.99	0.04	0.712	0.801	0.357	0.722
Artistic Choices	2.18	2.09	0.09	0.676	0.64	0.817	0.416
Mechanics	3.17	3.41	-0.24	0.615	0.553	-2.374	0.019

Table 9 displays the means (averages), standard deviations (a measure of the variation among the scores), and differences between the mean of the Treatment students and the control students. In this table the means representing the control condition are subtracted from the treatment condition means, so a positive difference indicates that the CFF mean was higher than the control. As we can see, the mean differences are relatively small, and with the exception of the "Body Language," "Use of Sources," and "Mechanics" are not statistically significantly different. ("Statistically significant differences" are differences that are large enough, given the variability in the scores that the differences are not likely to have occurred by chance. When we use the term "significantly different" in this report, it means that differences that large would not occur 95% of the time, if the subjects had been selected from pools that were not really different. This is consistent with educational research standards that generally accept differences with a 5% or less chance of occurring randomly as being "statistically significant.")

As noted above, the data presented in Table 9, which combines the three levels, we see that there are two statistically significant difference favoring Treatment (CFF students) on the "Body Language" and "Use of Sources," quantity of online sources cited in the

presentation. Conversely, the control condition students scored significantly higher on the ‘mechanics’ criterion, which demonstrates that there were fewer mechanical errors (spelling or grammar) with the control students’ presentations.

Knowledge Acquisition

In addition to the criteria used to assess the presentation itself, a test on Autism was developed to assess understanding of the content, probing for the sort of content that a skilled knowledge worker would define as important. This allows us to draw conclusions about the students' online research skills, and their ability to identify important content when working independently. Blind reviewers using an answer key scored the tests, and a T-test was used to test differences between the two groups to assess statistical significance.

In Table 10, we see the results of the analysis. Corresponding to the insignificant ‘content coverage’ finding in the presentations, the control and treatment groups were highly similar on their scores on the Autism Content Test.

Table 10: Content Test Analyses

Content Test	Mean Score (in percent)			Standard Deviation		T-Test	
	Treatment	Control	Difference	Treatment	Control	t value	P value
Overall	12.70	12.67	0.03	2.619	2.774	0.07	0.944

When it comes to answering the primary research question of this section, “Do the two groups learn more or less about the topic on which the presentation was based?” we can say with confidence there is no difference between the treatment and control conditions on the basis of this variable.

Group Problem Solving Task

To assess the group problem solving task, the video recordings of each group in action were scored by three blind reviewers using a checklist (See Appendix H) to identify behaviors associated with good teamwork (i.e. soliciting participation, supporting the ideas of others, building on the ideas of others, etc.) and negative or non-productive behaviors.

The differences between the means for each variable were analyzed using the T-test procedures to determine statistical significance. Table 11 lists the six variables present in the analysis. These variables were developed through a pilot test of the instruments and further qualitatively refined during the analysis. In addition, the *product* of the collaboration (the measurement of the distance of the cantilever produced during the task) was statistically analyzed using descriptive statistics and a T-test.

Table 11: Collaboration Task Teamwork Variables

Variable	Definition of Variable
Total Positive Behaviors	Total incidence of positive behaviors in each group.
Soliciting Participation	Student solicits or encourages participation of others or asks a question relating to task
Offering Suggestions	Student offers suggestions to others to complete task
Contributing Ideas	Student contributes an idea to help complete the task
Supporting Another Team Member	Student supports the idea of another or gives positive feedback / comments
Restates Problem	Student reframes the central problems involved in the task.

The analysis of the differences in the quality of the product (cantilever distance) reveals that the difference in mean scores was not statistically significant ($p=.245$).

Table 12: Cantilever Distance

Treatment		Control		t-tests	
Mean	Std. Deviation	Mean	Std. Deviation	t-value	p-value
11.67	17.521	5.38	10.353	1.19	0.245

The quality of the solution was but one variable studied through this task, the primary purpose of which was to focus on the degree of collaboration, specifically the kinds of interactions between group members. The focus of this part of our analysis was an attempt to resolve the question: Do students from Classrooms for the future Classrooms perform differently on a collaboration task (Group Problem Solving) than students from the control schools?

Table 13 below illustrates comparisons of the two types of group behaviors: the teamwork and leadership behaviors.

We performed group level analyses rather than individual level analyses, since group interaction was the object of the analysis. There were no significant differences among the teamwork and leadership variables (Table 13).

Table 13: Results for Teamwork Variables

	Mean			Standard Deviation		T-Test	
	Treatment	Control	Difference	Treatment	Control	t value	p value
Total Positive Behaviors	28.42	31.75	-3.33	11.897	14.257	0.656	0.518
Solicits Participation	6.67	6.38	0.29	3.367	4.272	0.195	0.847
Offers Suggestions	10.75	10.44	0.31	4.093	5.727	0.16	0.874
Contributes an Idea	2.83	3.19	-0.36	2.038	1.974	0.463	0.647
Supports Another Team Member	3.58	5.06	-1.48	2.575	3.623	-1.202	0.24
Restates Problem	4.58	6.69	-2.11	4.795	5.712	-1.031	0.312

The results for the collaboration and problem-solving tasks do not indicate a significant effect of treatment vs. control.

Creativity

The Torrance Figural Test of Creativity uses three picture-based exercises to assess five mental characteristics. Table 14 defines the different variables:

Table 14: Description of Torrance Test of Creative Thinking Variables

Variable	Description
Fluency	This score is based upon the total number of relevant responses. As such, it is perhaps one of the most critical parts of the test. All other scores depend in part upon the fluency score inasmuch as no subsequent scores may be given in other dimensions unless a response is first found to be relevant.
Originality	This score is based upon the statistical infrequency and unusualness of the response. As such it indicates whether a student produced a large number of relatively trite, common responses, (low originality) or unusual and highly imaginative responses (high originality).
Abstractness of Title	This score relates to the subject's synthesizing and organizing processes of thinking. At the highest level, there is the ability to capture the essence of the information involved, to know what is important, enabling this viewer to see the picture more deeply and richly.
Elaboration	The basis of this score is two underlying assumptions: the minimum primary responses to the stimulus figure is a single response, the imagination and exposition of detail is a function of creative ability
Resistance to Premature Closure	The basis for this score is a person's ability to keep open and delay closure enough to make a mental leap that makes possible original ideas. Less creative persons tend to leap to conclusions prematurely without considering the available information, cutting off chances for more powerful, original images.

(Scholastic Testing Service, 2008)

The scoring of this test was conducted by the Scholastic Testing Service, which, in addition to raw scores, provides both grade based standard scores (this enables the averaging of the standard scores across grades to obtain a score reflecting the assessment based upon the pooling of the norm-referenced assessments) and also a national percentile for each variable (enabling comparison of any student, or groups of students, with the performance of the same grade in a national sample).

Overall, the results were mixed, with the treatment condition exhibiting certain strengths and conversely the control condition exhibiting other areas of strength. In Table 15 we see both the overall grade based creativity score and the overall grade based national percentile. On the elaboration variable (a measure that shows how the imagination and associated exposition of detail as a function of creative ability) the treatment students outperformed the control students ($t=10.753$, $p<.001$). Also with the 'Resistance to Premature Closure' variable (a measure that shows how open the students are to 'broaden the creative horizon' and extend the narrative of their pictorial study in both common and uncommon ways), students in the treatment condition outperformed their control peers ($t=2.070$, $p=.040$) as seen in Table 15.

Table 15: Overall Creativity Analyses

	Mean			Standard Deviation		T-Test	
	Treatment	Control	Difference	Treatment	Control	t value	p value
Resistance to Premature Closure	15.15	13.92	1.23	3.321	3.495	2.070	0.040
Fluency	22.48	24.89	-2.41	5.703	7.414	-2.075	0.040
Originality	17.30	17.06	0.24	4.866	5.629	0.260	0.795
Elaboration	6.95	4.56	2.39	1.231	1.320	10.753	0.000
Abstractness of Titles	8.33	9.72	-1.39	3.081	4.015	-2.215	0.028

Control students scored significantly higher on the measure of ‘Fluency’ ($t = -2.075$, $p = .040$) and ‘Abstractness of Titles’ ($t = -2.215$, $p = .028$). The Fluency variable measures the total number of relevant responses embedded in the overall narrative of the students’ responses. The Abstractness of Titles variable describes the imagination and creativity involved in the formation of titles for the individual items (pictures) of the student’s narrative. Despite showing significant differences on two variables, the treatment condition students can not be said to have outperformed their control peers on the measure of creativity.

Formal Reasoning Skills

The Arlin Test of Formal Reasoning, used to assess thinking skills, incorporates eight different variables. The exam was proctored to ensure similar testing conditions, with the same instructions and level of monitoring given to treatment and control groups. Results of the Arlin were scored and calculated by the evaluation team. The eight variables under evaluation are listed in Table 16.

Table 16: Description of Arlin Variables

Formal Schemes	Description of Variable
Volume	Multiplicative Compensation. The concept which supports the understanding that when there are two or more dimensions to be considered in a problem, gains or losses in one dimension are made up for gains for losses in another dimension.
Correlations	A concept that implies the ability of a student to conclude that there is or is not a casual relationship, whether negative or positive, and to explain the minority cases by inference of chance variables.
Probability	A concept that supports the ability to develop a relationship between the confirming and the possible cases.
Combinational Reasoning	Involves the concept of generating all possible combinations of a given number of variables, choices, events, and scenarios when a problem's solution requires that all possibilities be accounted for.
Proportional Reasoning	This variable is defined as a mathematical concept that involves the ability to discover the equality of two ratios that form a proportion.
Moment	Forms of Conservation beyond Direct Verification. This variable is narrowly defined in terms of scientific concepts. It involves the ability to deduce and verify certain conservations by observing their effects and inferring their existence.
Mechanical Equilibrium	The idea of equilibrium represents the coordination of many different sets of conservations so that a balance or equilibrium is maintained.
Frames	Coordination of Two or More System or Frames of Reference. It is a bridging concept between formal and post-formal thinking. It represents a kind of relativity of thought. This concept requires the ability of coordinate two systems, each involving a direct and an inverse operation.

(Slosson Educational Publications, 1984)

A "total" category was also calculated. T-tests were performed to compare the treatment and control group performances overall and on each of the subscales. There are no significant differences between the control and treatment cohorts on the measure of formal reasoning.

Table 17: Arlin Analyses Overall

	Mean			Standard Deviation		T-Test	
	Treatment	Control	Difference	Treatment	Control	t value	p value
Total	17.79	18.11	-0.32	4.875	5.364	-0.363	0.717
Volume	2.46	2.53	-0.07	1.373	1.391	-0.287	0.774
Probability	3.18	3.14	0.04	0.904	0.952	0.230	0.818
Correlations	3.05	3.30	-0.25	1.071	1.108	-1.313	0.192
Combinational Reasoning	1.61	1.29	0.32	1.100	1.051	1.705	0.091
Proportional Reasoning	2.08	2.09	-0.01	1.333	1.462	0.015	0.988
Moment	1.08	1.47	-0.39	1.053	1.282	-1.882	0.062
Mechanical Equilibrium	2.26	2.20	0.06	1.109	1.175	0.311	0.757
Frames	2.07	2.10	-0.03	1.167	1.181	0.167	0.867

There are two measures which are on the margins of nearing significance, the 'Combinational Reasoning' and the variable describing 'Moment,' which show large mean differences in favor of the treatment condition. The combinational reasoning variable (a measure that shows how students make sense of different variables) shows a mean difference of .32 ($t=1.313$, $p=.091$). Similarly, the measures of Moment (the ability to deduce and verify certain scientific precepts), shows large mean differences ($t=1.882$,

$p=.062$) which near the accepted measure of statistical significance in the Social Sciences.

Discussion

The results in terms of creativity were mixed. The treatment cohort showed strengths on such variables as Elaboration and Premature Closure. The control cohort showed strengths on the measures of Fluency and Abstractness of Titles.

The results in terms of formal reasoning were also mixed, with no significant differences between the treatment and control groups, although mean differences favoring the treatment condition approached but did not reach the level associated with statistical significance.

A group problem-solving task was also videotaped and analyzed by blind reviewers for differences in teamwork and group processes as well as the quality of the solution. There were no significant differences between the treatment and control cohorts on the problem solving and teamwork task.

A 'Ill-Structured' Presentation Task showed significant differences favoring the treatment condition in the areas of 'Body Language' and 'Use of Sources.' Meanwhile the control students excelled on the 'Mechanics' variable.

Overall, it appears that differences favoring the Treatment students may indeed exist, but because we were not able to randomly assign students to treatments or to use other measures to account for what may have been existing differences between the two populations, it is not possible to discern, with certainty, that these differences were caused by the presence of higher levels of technology in the district. More research appears warranted, and studies that compare the performance of Treatment students to themselves and to national norms as they move through the grades with technology-enhanced teaching would be especially valuable.

Conclusion

Classrooms for the Future is changing teaching and learning in Pennsylvania's high school classrooms. The combination of increased access to technologies and professional development designed to help teachers move from didactic teaching methods to active, learner-centered practices is changing how teachers teach and how students learn.

From our vantage point, having reviewed the data from teacher and student surveys, classroom observations, and interviews with key players, we are confident that important changes have begun. However, care must be taken to ensure that the progress that is evident continues and expands, as changes of this magnitude alone may not be sufficient to bring about the increases in student achievement and 21st century skill development that the program set out to accomplish. The changes must expand both in terms of the numbers of teachers making progress and in terms of the magnitude of the changes if they are overpower the gravitational pull of thousands of hours of past practice and produce changes of magnitude in student achievement and success in life after school.